AUGUST 28, 1985 VOLUME 19, NUMBER 36A

COMPUTERWORLD FOCUS

UNTANGLING THE NETWORK TIE-UP

IBM'S NETWORK STRATEGY — WILL IT SURFACE?

AT&T'S ISDN DEAL — WHAT'S IN IT FOR YOU?

PBX VS. LOCAL NETS — IT'S TIME TO DECIDE.

ANN ARBOR MI 48106

Contents

COMPUTERWORLD FOCUS

CW COMMUNICATIONS/INC.
Box 880, 375 Cochituate Road,
Framingham, Mass. 01701

Editorial Director/Editor
Ann Dooley
Managing Editor
Nancy Fleming
Senior Writers
Stan Kolodziej
Lee White
Senior Copy Editor
Emily Alter
Editorial Assistant
Karen Wallace
Advertising Traffic
Suzanne Weixel
Focus Publications Administrator
Jenny Charlesworth
Production Director
Peter Holm
Art Director
Tom Monahan
Production Manager
Marlene Stibal
Typesetting Manager
Carol Polack
Art Assistant
Geoffrey J. O'Connell
Production Assistant
Stephen DeLacy
Paste-Up Manager
Patricia Gaudette
Paste-Up Artist
Jeffrey Robinson

Board Chairman
Patrick J. McGovern
President
W. Walter Boyd
Executive Vice President
Lee Vidmer
Publisher/VP
Donald E. Fagan
Senior VP-Communication Services
Jack Edmonston
Group VP-Circulation
Margaret Phelan
Vice President/Sales
Edward P. Marecki
VP-Finance
William P. Murphy

Second-class postage paid at Framingham, Mass., and additional mailing offices. *Computerworld* (ISSN-0010-4841) is published weekly, except: January (5 issues), February (5 issues), March (5 issues), April (6 issues), May (5 issues), June (5 issues), August (5 issues), September (6 issues), October (5 issues), November (5 issues), and a single combined issue the last week in December and the first week in January by CW Communications/Inc., Box 880, 375 Cochituate Road, Framingham, Mass. 01701.

Computerworld subscription prices: $2.00 a copy; U.S. — $44 a year; Canada, Central & So. America — $110 a year; Europe — $165 a year; all other countries — $245 a year (airmail service). *Computerworld Focus* price: $5.00 a copy. Four weeks notice is required for change of address. Please allow six weeks for new subscription service to begin.

Computerworld can be purchased on 35mm microfilm through University Microfilm Inc., Periodical Entry Dept., 300 Zeeb Rd., Ann Arbor, Mich. 48106. *Computerworld* is indexed; write to Circulation Dept. for subscription information.

ABP

POSTMASTER: Send Change of Address to Computerworld Focus Circulation Dept., P.O. Box 1016, Southeastern, PA 19398-9984.

Computerworld Focus is a member of the CW Communications/Inc. group, the world's largest publisher of computer-related information. The group publishes 55 computer publications in more than 20 major countries. Nine million people read one or more of the group's publications each month. Members of the group include: Argentina's *Computerworld/Argentina*; Asia's *The Asian Computerworld*; Australia's *Computerworld Australia*, *Australian PC World* and *Macworld*; Brazil's *DataNews*, *MicroMundo* and *PC Mundo*; China's *China Computerworld*; Denmark's *Computerworld/Danmark*, *PC World* and *Run (Commodore)*; Finland's *Mikro*; France's *Le Monde Informatique*, *Golden (Apple)*, *OPC (IBM)* and *Distributique*; Germany's *Computerwoche*, *Microcomputerwelt*, *PC Welt*, *Software Markt*, *CW Edition/Seminar*, *Computer Business*, *Run* and *Apple's*; Italy's *Computerworld Italia* and *PC Magazine*; Japan's *Computerworld Japan*; Mexico's *Computerworld/Mexico* and *CompuMundo*; The Netherland's *Computerworld Benelux* and *PC World Benelux*; Norway's *Computerworld Norge* and *PC Mikrodata*; Saudi Arabia's *Saudi Computerworld*; Spain's *Computerworld Espana*, *PC World* and *Commodore World*; Sweden's *ComputerSweden*, *Mikrodatorn*, and *Svenska PC*; the UK's *Computer Management*, *Computer News*, *PC Business World*, and *Computer Business Europe*; Venezuela's *Computerworld Venezuela*; the U.S. *Computerworld*, *Hot CoCo*, *inCider*, *Infoworld*, *MacWorld*, *Micro Marketworld*, *PC World*, *Run*, *73 Magazine*, *80 Micro*, *Focus Publications* and *On Communications*.

COVER PHOTO ©1985 ED BRAVERMAN

LETS YOU BE MASTER OF YO[illegible]

automation equipment; isolated Ethernets™ AT&T's STARLAN PC Network and 3B Net; smart and dumb—ISN gets it all working together. All sharing the same resources. With you in total control.

And what about those IBM 3270s? ISN makes them work even harder. Now your 3270 terminals can access multiple IBM hosts. And low-cost dumb terminals can do the same. Asynchronous and synchronous traffic can travel through your network with the same speed and efficiency.

You can handle heavy traffic.

ISN maintains a high end-to-end transmission speed of 8.64 mbps, and a high throughput rate even when traffic is at its peak.

Long messages or bursty transmissions—ISN's been engineered to handle it all. A unique centralized short bus and perfect scheduling access method permit messages to travel through the network almost instantaneously. And arrive with their integrity intact. So there's no waiting. No bottlenecks. No retransmitting data.

You've made the right connection.

AT&T has a long history of solving complicated networking problems with clear-cut, intelligent solutions. We know how to tie it all together. And we know how to work with you. Our professional sales and service people are with you every step of the [illegible] ing and maintaining a network that will meet your [illegible] today and tomorrow.

ISN reflects AT&T's better approach to office automation. To learn why it's the right choice for your business, call your AT&T Information Systems Account Executive, or 1 800 247-1212.

AT&T
The right choice.

Editorial

Back to the Good Old Days?

In the old mill and mining towns of yesteryear, the townspeople bought their provisions from the company store — they had no other choice. The town's one main company employed them and sold them all their supplies. It was called keeping it all in the family.

In its quest for market share, IBM may be resurrecting those good old days by putting a lock on users' choices. It almost seems that prior commitment to IBM — and who isn't committed to IBM — may leave little for users to choose from in their communication needs. With its integrated approach to systems development, IBM is attempting to instill in users a cradle-to-the-grave solution that could lock up communications alternatives in the same way much of the computer hardware environment has been locked up.

IBM's aggressive pursuit of market share is clearly evidenced in its recent acquisitions and alliances. Its acquisition of Rolm Corp. provides a major entree into the PBX market and its new alliance with MCI Communications Corp. ensures access to a major long-distance carrier. The IBM-compatibles, in fact, may find themselves edged out as IBM tries to make systems that are more interdependent — meaning you can't get one piece of equipment without the other.

IBM, of course, is trying to challenge AT&T on that company's own turf. While AT&T is attempting to develop and market computers, IBM's strategy is to acquire telecommunications companies to quickly utilize their technologies in the coming battle between the two giants.

Almost all the major computer companies have adopted the "if you can't beat them, join them" philosophy in recent months. Digital Equipment Corp., Data General Corp. and Wang Laboratories, Inc. have recently announced or broadened their technology to connect their equipment with IBM. And AT&T will undoubtedly soon be offering hardware and software packages allowing its equipment to exchange documents with IBM mainframes.

While all of this market maneuvering is occurring, the MIS manager is still left with lots of gaping holes in IBM's telecommunications offering. This cloud hanging over any communications decision rests on what IBM will offer, particularly in local-area networks. The wait has been a long one, and no one is assured that it will be worth it.

So users are once again caught in the middle. The devil riding on every MIS manager's shoulder is the fear of making a decision that would make life more difficult in working with IBM's present and future product path.

IBM will call what's happening healthy competition, but users caught in the middle may have other words for it.

Insider

Not-So-Radical Perspectives

By Thomas Willmott

International Data Corp. has long tracked the progress of distributed resources systems (DRS) to describe the future of large organization computing architectures. In 1981, we looked forward to networks of processors that automated business functions far beyond the walls of the data center and that could, in fact, provide computing power and information access to a universal audience of end users. These concepts are driven by networking technology.

It is to be expected that all members of an organization — whether on the factory floor, in the reprographics center, throughout the administrative and sales offices or in the traditional data processing facility — would eventually be the beneficiaries of personal computing and global information access. This was a radical perspective, however, until recently.

DRS continue to evolve, and our research presently considers these three network categories: back-end (represented by high-speed mainframe connectivity), distributed data (reaching the local-area nodes) and microcomputer networks (that serve the work group). These distinct networks are complemented by gateway utility conversion products that have begun to tie together each piece of the DRS.

Back-end communications provide multimegabit-per-second file transfer among large CPU. IBM offers back-end channel adaptor technology to its customers, but the multivendor mainframe connection market is largely dominated by Network Systems Corp. (NSC) and its Hyperchannel products. NSC provides CPU adaptor devices and Netex, a proprietary network control program, to execute its high-speed network strategy. Paradyne Corp. and Masstor Systems Corp., while not providing precisely the same type of back-end products, are active participants in the market. Digital Equipment Corp.'s VAX Cluster is also a contender in the back-end communications battle that looms before us.

Distributed data networks are used to connect nodes on the next level of a processing hierarchy. Many of these installed networks conform to IEEE local-area network standards: 802.4 in manufacturing (General Motors Corp.'s Manufacturing Automation Protocol project is an good example); 802.5 token ring, which may be used to network multiple IBM System 36 or other departmental processors; and 802.3 carrier-sense multiple access with collision detection (CSMA/CD) Ethernet/Decnet, which corporations such as Ungermann-Bass, Inc. have had substantial success with. These distributed data networks typically provide for communications one level below the large data center CPU and one level above the individual's workstation.

At the low end — but by no means the least important — is PC Cluster. Substantial growth has occurred in this market over the past 12 months, and dramatic increases in microcomputer work group networks can be expected over the next three years. The technology here is clearly moving to IEEE 802.3 standards. A number of exciting young companies — 3Com Corp., Novell, Inc. and Sytek, Inc. are the first three that come to mind — are defining boundaries of the work group cluster.

The promise of global communications has not yet been kept. Gateway Technology and International Standards Organization (ISO) presentation standards are still evolving. Applications software integration in multivendor environments (and across multiple IBM systems) is still the Achilles' heel of DRS. IBM's Logical Unit 6.2 standards are promising, but usable products have yet to be delivered. Multiuser software for PC Networks is in alpha test, not in the office. And integration of voice and data networks continues to elude us.

Nevertheless, tremendous progress has been made in all areas of the communications industry. As the following pages attest, prospects for all types of networking products and companies have never been better.

Information Systems departments are excited by networking technology, and executive management has recognized the potential of DRS as a competitive tool.

Willmott is vice-president of user services for International Data Corp. in Framingham, Mass. and a regular columnist for Computerworld Focus.

Computerworld Focus

Computerworld Focus will be published 10 times in 1985. Remember, it's *your* publication. Send your comments on what you like and don't like and on what you want to see included to The Editor, Computerworld Focus, 375 Cochituate Road, Box 880, Framingham, Mass. 01701.

CW subscribers will continue to receive issues as part of their subscriptions.

Good Things Come to Those Who Wait . . .

By Jim Young

We have all heard the old platitudes — patience is a virtue, good things come to those who wait and watched pots won't boil and all the rest. However, given the current state of communications offerings, wait and see has become something of a necessity for today's data processing manager.

Indeed, biding time is almost a survival tactic today as managers try to anticipate the trends of communication technology, time their own investment, react to their organization's pressure for improved services and avoid premature commitment.

The experienced manager is lucky to have had a lot of on-the-job training in how to wait. When Winchester disk technology was introduced, years went by before products that fit into many environments were announced. When memory prices started falling dramatically, managers had to explain to impatient executives that their companies could not reap the benefits from lower priced technology until leases on old equipment expired and, even then, would have to migrate to the new technology.

However, these improvements were all technical. Unless the speed of light can be increased, we can expect no basic change to the technology of communications. With the possible exception of fiber optics, the delay in the convergence of communications technology is for standardization and integration of known technology. But when the jigsaw puzzle comes together, it will have been worth waiting for.

After all, the potential of networks that could include all remote applications, all users, multiple vendors, batch and interactive transmissions, data and voice as well as document and image is enormous. Unfortunately, this environment is not available today.

Many growing pains affect the communications industry and leave most of today's offerings "not ready for prime time." Anyone who has tried to get true compatibility between modems from various vendors knows we are a long way from standardization.

Any hope for progress in merging technologies took a giant step backwards when the AT&T breakup occurred. Further delays can be expected as this new competitive environment tries to reconstruct the simplicity that existed before. This process will take some time as new vendors like IBM step into the arena and add new dimensions to the compatibility problem.

Today's managers must deal with a difficult situation — finding offerings that can fit into the existing environment. Several solutions exist for those with the luxury of starting from scratch. However, where existing data or applications must be included, either immediately or eventually, finding compatible communications products is difficult.

Local-area networks are a good example. When Datapoint first pioneered this concept with Arcnet, the problem was not that the company didn't have a fine product, but that it was hard to fit Arcnet within the then-typical DP network.

In a similar situation, the advent of voice-over data products has a real disadvantage — it is largely unable to work using existing wiring schemes and is therefore not practical unless a user starts all over again. To accommodate this possible future environment, DP managers can only hope to have a plan of how they can migrate to a future environment that is only a fuzzy concept today.

One waiting strategy is to pick a direction that looks promising and hope that as the whole architecture develops (one piece at a time), the total solution arrives on time and intact. This approach is not for the squeamish; investing in an undeveloped product may lead to a dead end or frustrating detours, as those who are pinning their hopes on products like Ethernet know.

The same drawbacks are true for IBM's SNA approach. The only difference is that a large number of people are betting IBM will once again be able to coerce the market. However, even the IBM followers are beginning to get an uneasy feeling as SNA takes shape around its various announcements. Other IBM products, such as document filing, do not fit within a smoothly integrated office environment, a key expectation of the communications environment. Moreover, long-term issues exist, such as those connected with potential voice or image protection: Will performance be there? Will IBM commit to necessary products? Once again, managers are forced to wait and see.

This confusion requires DP managers to take special care. Regardless of how aggressive or conservative a path one follows, some fundamental rules can be used to advantage, among them the following:

Manager's Corner

. . . But This Is Getting Ridiculous!

• Whether or not you want to commit to a technical direction, a strategy must be defined to include the applications that meet your business needs. Remember, even though communication capabilities can be elaborate, your needs may not be.

As you support your environment, focus your discussions around these applications. You can bring daydreaming executives and rabid vendors back to reality by talking in terms of the business benefits within your organization.

• Don't be afraid to commit to interim technology or products to solve specific localized needs. Just don't confuse this with a complete answer. The long-term solution will continue to grow in size and scope, but it's probably not on the market today.

• Beware of too stringent cost-benefit analyses.

Investment in a communications network pays back through the many applications that can use it. Frequently this takes time and the right combination of communications products. Culmination of this investment may take several years.

• Keep your technical skills and knowledge current at all times. New announcements constantly change the potential direction of this turbulent marketplace.

Begin building a strong technical staff whose skills can manage and grow a communications network. This talent will not appear overnight; it's best to start now.

• Keep an eye on what your colleagues are doing.

When the right combination of products is announced, others are sure to take advantage of integrated offerings, giving you a key tip-off to what may work in your environment.

Until the confusion of the communications environment straightens out, DP managers must understand the risks inherent in any long-term communications investment. The tremendous benefits available from an integrated communication network make it worthwhile to wait for the development of the proper products that will fit the larger picture.

Until this happens, all managers will have to become specialists in the techniques of waiting.

Young, a new columnist, is management information systems director and responsible for user technology at Wright Line, Inc. in Worcester, Mass. He has been working in the industry for 15 years.

Letters

The Spirit of Lukens

Your article in the June 19 issue of *Computerworld Focus* caught the spirit of our efforts.

Systems and process control have been elegant tools for our people — not the converse.

We appreciate your accurate portrayal.

A. H. Aronson
President and Chief Operating Officer
Lukens Steel Co.
Coatesville, Pa.

Lots of Gears — So What?

Artistic license or simply a visual bit of editorializing on the quality of software designed to control manufacturing processes?

Whichever — the Rube Goldberg gismo on the cover of *Computerworld Focus* [June 19] just won't work. Gives one the impression of the mechanical equivalent of an infinite do-loop.

Actually, it looks rather like some of the software systems I've tried — lots of gears and mechanisms — and nothing much happens.

Gil Klajman
The Markham Co.
Research Services, Inc.
New York, N.Y.

Computerworld Focus Welcomes Your Letters

Computerworld Focus welcomes letters from its readers. In case of limited space, preference will be given to typed, double-spaced letters of 150 words or less. *Computerworld Focus* reserves the right to edit letters for clarity and brevity.

Please address your letters to The Editor, *Computerworld Focus*, Box 880, 375 Cochituate Road, Framingham, Mass. 01701.

Q&A

Telecommunications consultant and noted industry analyst Dixon R. Doll is founder and president of the DMW Group, Inc., a consulting and research company in Ann Arbor, Mich. He recently shared with Computerworld Focus *some of his views on the current status and future directions of data communications.*

How far are we from true voice, data and image integration?

We're very slightly down the path. Some people paint a grand vision of the totally integrated all-digital network, but even in the middle of the twenty-first century there will probably be bits and pieces of those networks that won't be fully integrated.

Can you characterize the direction in which we're moving?

Where we're going can be characterized in terms of the networks, including all the transmission facilities, switchers and, to a great extent, many of the applications engines that drive the networks. All those will be based on the use of digital technology. Voice will become just another class of user of these digital nets. The model of the future is clearly the ISDN [integrated services digital network].

But that answer focuses only on the technology. We have lots of bits and pieces of the networks, but the deployment of the digital networks is more of a patchwork quilt. Many so-called networks only partially allow the objectives of universal networking to take place. And many networking products that the various vendors have pitched into the marketplace create incompatibilities and make it difficult for this universality to take place.

During the last two or three years, a tremendous wave of renewed interest has taken place in open networking. The major DP vendors in Europe decided the enemy was IBM. Then they decided they'd all be better off if they collaborated to develop common rules, standards and protocols that would allow all their machines to interconnect freely and to intercommunicate. This effort is paving the way for some improvements and enhancements and for the so-called OSI [open systems interconnection].

Do you think the U.S. will follow Europe's lead in banding together against IBM?

No. In the U.S., there is no belief that either the government or individual computer companies needs to compete against IBM. The two that will set the standards in the U.S. are AT&T and IBM. It won't be that much different from the case of local-area networking, where the battle was between supporters of the token passing ring and the Ethernet camp.

You'll also see joint ventures and collaborations. One good example is Wang and DEC in the office automation area; each company has announced it will comply with IBM's standards in the document interchange and document content architecture. Wang would most assuredly say that its main competitor is IBM and that its most important task is a coexistence strategy so customers don't have to choose between Wang and IBM.

Do you think that this concentration on the part of major vendors is going to further the shakeout of the smaller ones?

The shakeout we're seeing right now is a direct manifestation of the lack of concern many vendors have shown over developing broad-based communications strategies. Lots of Apples and IBM PCs bought in the last three years now sit around collecting dust. Why? Because they can't be attached to a local-area network, or they can't extract information or get at data necessary to run spreadsheet packages and decision support systems at the end-user workstation.

In the News

Stacking the Deck With MCI Acquisition

IBM Corp. made an impressive move in its quest to become a serious player in the communications market recently when it announced its intention to acquire up to 30% of MCI Communications Corp. (MCI) of Washington, D.C. IBM's communications strategy in fact counterbalances rival AT&T's strategy in the computer field.

In the first place, IBM has unburdened itself of its unprofitable Satellite Business Systems (SBS) operation, handing it over to MCI. From its inception SBS had been an uncomfortable fit for IBM, according to a recent industry bulletin from International Data Corp. (IDC), a market research firm in Framingham, Mass. "From a strategic and organizational standpoint, [the agreement] is nothing but positive for IBM," the IDC bulletin pointed out. "IBM gets out of the day-to-day operations of SBS and gets SBS off of IBM's bottom line. IBM hands SBS over to a company with a good track record in long distance. IBM gets a major piece of what will be a much stronger long-distance carrier. The deal is a short-term, tactical retreat for IBM, but it is a strategically aggressive move in the long term." The move also gives MCI direct access to the confused but still-promising industry of satellite data communications. With an installed SBS base of 200,000 customers combined with its own customer base of 2.5 million, MCI could in a flash become more than twice as big as GTE Sprint Communications Corp. of Burlingame, Calif., the third largest long-distance telephone company.

MCI might also get the substantial backing it needs to expand its long-distance facilities while providing a path to the communications future beyond the intensely competitive and relatively unstable present market of long-distance telephone services.

For the lower tier competitors, the IBM/MCI venture does not bode well. GTE Sprint will be pressured to scramble for more customers, especially for high-volume business accounts (given MCI's access to SBS's 200,000 large customer accounts). James Broadhead, president of GTE's communications services group has stated GTE does not intend to change its present strategy, contending the MCI/IBM alliance is basically a tempest in a teapot. "It really doesn't show a major commitment by IBM yet," Broadhead said.

Others, such as Allnet Communication Services, Inc. in Chicago and United Telecommunications, Inc. in Kansas City, are thought by many industry watchers to be placed in jeopardy by the alliance. Allnet has announced its intentions to go into servicing specialized communications niches, which the larger companies might not find profitable enough. Charles Skibo, president of United Telecommunications, said his company would be increasing its development of private fiber-optic networks.

Some industry analysts are more blunt, predicting that a shakeout is around the corner unless the smaller long-distance companies can form some sort of consortium to bring economies of scale to bear on an intensely competitive market. If not, the long-distance telephone industry could become a two-company race.

Companies' OA Needs Drive PBX Selections

A study of office communications by New York-based Omni Group Ltd. found that 26% of decision makers surveyed considered their office automation communications needs exerted a heavy influence over their selection of a PBX system. An additional 60% said their communications needs exerted moderate influence in PBX selection. Only 14% said it had no influence whatsoever.

More than 500 OA purchasers in 2,000 large industrial companies and 2,000 large service companies in the U.S. were interviewed for the study, according to David Cushing, associate director of The Omni Group, a research and consulting firm specializing in technology.

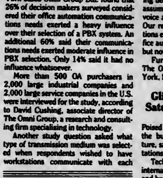
Another study question asked what type of transmission medium was selected when respondents wished to have workstations communicate with each other. Approximately 39% of the respondents said they used current phone wiring; 35% said they installed new phone wiring; 18% said they used their existing data communications network (which includes IBM 3270 terminal wiring); and 8% said they used some other choice (primarily fiber optics).

What can be concluded from these statistics? According to Cushing, "The more people who said that their office communications needs drive their PBX purchasing decisions, the more people we could assume are getting into highly integrated voice and data applications in the office. Our results suggest that when corporations evaluate digital PBX equipment, office automation objectives are influential but not decisive."

Further information is available from The Omni Group, 115 E. 57 St., New York, N.Y. 10022.

Glitches, Expense Cause Satellites' Fall From Grace

Poised just a few years ago as the wave of the business data communications future, satellites are falling short of expectations.



Technical glitches and wrangling over international transmission techniques and broadcast boundaries slowed the development of satellite data communications in the late 1970s and early 1980s. Add to that the average $100 million cost of a satellite and the average satellite life expectancy — between seven and 10 years — and you have a problem. Why are satellites so expensive? One reason is that they are not mass produced. They have to be lightweight enough and their circuitry must be tiny enough to be carried into space by a National Aeronautics and Space Administration shuttle or a European Space Agency

Q&A

Vendors are paying the price right now, and they're all scrambling. John Young, head of Hewlett-Packard, said the solution to getting out of the jam is to broaden the communications capabilities and to become more effective in a systems integration role.

Are vendors following Young's advice?

Lots of examples are just beginning to hit the surface — the AT&T Information Systems/EDS joint venture and IBM's fledgling efforts to design custom networks that might possibly include other vendors' equipment.

Users are tired of being locked into dealing with only a narrow product set of particular vendors. They want single-vendor support with the ability to mix and match boxes and devices and special functions under the management leadership of the so-called integration vendor.

Did Apple err when it introduced the Macintosh and said it didn't have to talk to IBM?

Apple has already rewritten its strategy. The significance of Apple as a player in the computer industry will be a function of how well it coexists with IBM. If Apple had paid more attention to communications from the beginning, it wouldn't have found it so bloody difficult to get into the business environment. Apple should have had a greater sense of vision about what was important in communications when its products were closed off at the pass in terms of impacting the IBM business user.

You mentioned earlier that the two interconnect leaders will be AT&T and IBM. What will AT&T's role be?

AT&T's influence will be felt predominantly in the areas of the premises controller and the PBX and in its influence in the marketplace on standards for connectivity on the premises and in the long-haul market. AT&T has gone on record saying it will spend $500 million over the next few years enhancing the System 85 PBX. The company is a massive player and will have a very significant influence on the kinds of things people can do on the premises. AT&T will continue to utilize the PBX as a way of motivating customers to implement high-productivity OA applications — not necessarily keyboard-sensitive applications, but the more innovative ones like voice mail, teleconferencing and document composition distribution. It's already setting de facto standards in office wiring and cabling. Each time AT&T puts in a PBX, it usually gets its customer to put in [AT&T-recommended] wiring and cabling.

Does AT&T have a lock on that part of the market?

The trend in the marketplace is for both AT&T and IBM to separate the PBX selection process from the building wiring and cabling systems selection process. This trend is yet another manifestation of how AT&T and IBM are going to be the two leading factions in networking.

The vendor that supplies the PBX and the wiring and cabling system is going to be in a very attractive position with respect to getting a lot of additional add-on applications. That vendor will certainly be in a position to drive and control the local-area network protocols, so a lot of buying will be going on.

That's the good news. The bad news is this buying won't happen until companies are satisfied and comfortable that they can glue all this stuff together. It's going to take quite a few more years before all these problems are sorted out. In the meantime, systems integrators and internal telecommunications people will be in great demand.

Where are most users now?

Right now the vast majority of companies we work with have identified high-payoff application opportunities. One thing everybody is doing today is installing an all-digital backbone network deploying T1 facilities. The key to success in this type of undertaking is the ability to manage the T1 facilities as a network itself — to dynamically share the capacity across different applications.

— Lee White

In the News

rocket. Satellites must also be incredibly reliable because they can't be repaired when they are in orbit. Finally, the precision of their controls has to be exact, more so than for their terrestrial data communications counterparts. Even the smallest deviation in their controls can render the satellite inoperable and plot a course of disaster with no hope of recovery.

Though nations and international standards organizations are still coming to terms on broadcast boundaries, many of the transmission details have in the meantime been ironed out. Geostationary satellites operate in two frequency bands. The C band operates in the 4 to 6 GHz range, and the Ku band operates in the 12 to 14 GHz range. Antenna size is an inverse of frequency; a C band therefore needs a very large antenna.

To date, satellite data communications has had tepid response from U.S. businesses. Though satellites remain unsurpassed as the technology for broadcasting to remote distributed sites, most satellite business has come from government and private weather agencies and television broadcast stations, not from private business. Despite the growing improvement and miniaturization of sending and receiving earth stations, satellites are getting stiff competition from other forms of bypass technology such as fiber-optic and microwave networks. The latter networks often prove to be less expensive, more reliable data carriers and important links in long-distance terrestrial data networks.

Aggravating the situation is a glut of data communications satellites. Demand already is well below the supply of satellites now in geostationary orbit. Telesat Canada recently sold its Anik C1 satellite before it was scheduled to be launched, and companies such as Allstate Insurance Co. of Northbrook, Ill., and Merrill, Lynch, Pierce, Fenner & Smith, Inc. of New York are looking for buyers for part of their unused satellite capacity.

There is some hope. Mobile communications is one alternative. Many say the spread of mobile communications in the latter part of the '80s could provide a stimulus for satellite business communications. In this scenario, the satellite would provide the key link in a worldwide communications chain among mobile telephones.

A Surfeit Of Standards

In the beginning, there were too few communications standards; now there might be too many.

That's the opinion of Subhash Bal, vice-president of marketing for Excelan, Inc., a network vendor in San Jose, Calif.

Communication standards are beneficial, Bal explained, because they bring down costs and help the industry grow. In light of the current computer industry slump, Bal said, users are going to pressure vendors to "standardize" on fewer standards.

"In any given organization or department there is always a variety of systems. The time has come for people to get more out of existing systems by making them communicate with each other. It's impossible with so many operating systems and vendors. The only way is to adopt a standard and eliminate the differences in the operating systems among computers."

According to Bal, the time might be near. Standards in communications can be divided into two areas. The first is the standard related to the medium itself and includes things like Ethernet, baseband and broadband, token bus or token ring, speed of transmission. These characteristics are based on the actual physical connection of the network.

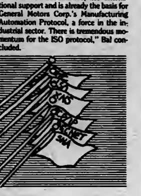
The second area that Bal classified as more important is the communications protocol, the set of conventions by which two computers can "talk to and understand each other." Bal likened this area to the ability of two people to carry on a conversation in a certain language.

A number of communications protocols exist — Decnet from Digital Equipment Corp. and XNS from Xerox Corp., for example. Some are better than others, but Bal believes the transmission control protocol/internet protocol (TCP/IP) may have a good chance to succeed. TCP/IP is available, complete (after 15 years of work by the U.S. Department of Defense, its developers), well documented and growing in popularity.

IBM's Systems Network Architecture (SNA), celebrating its 10th birthday, will be around for a long time simply because it is IBM. Otherwise, it has network shortcomings, Bal noted. SNA works in a layered, hierarchical network approach, as contrasted with the peer-to-peer approach TCP/IP, XNS, Decnet and others offer. "Most people install SNA emulators," Bal explained, "when they wish a non-SNA computer to talk to another computer that is on the SNA network. It simply provides a way to make the outside computer act like an IBM terminal to communicate with the IBM 370 computer on SNA."

Bal had some predictions for five years down the road: the eclipse of more proprietary networks such as Decnet and XNS; the beginning of the decline of fast riser TCP/IP; and the emergence of the still-to-be-completed International Standards Organization (ISO) protocol, which he thought would be the big data communications winner.

"It is well documented, has international support and is already the basis for General Motors Corp.'s Manufacturing Automation Protocol, a force in the industrial sector. There is tremendous momentum for the ISO protocol," Bal concluded.



In Brief

FRANKLIN LAKES, N.J. — Implementation of the integrated services digital network (ISDN) communications protocol in the U.S. is inevitable, but will evolve slowly over the next 15 years with limited network capability appearing in about five years, according to a recent study announced by the Perspective Telecommunications Group, a telecommunications consulting firm. The study also concluded that the primary market for ISDN will be intra-local access and transport area network applications, and the major beneficiaries will be local telephone companies and user corporations with sufficiently diverse circuit requirements to utilize ISDN.

Further information is available from Perspective Telecommunications Group, 808 High Mountain Road, Franklin Lakes, N.J. 07417.

RYE BROOK, N.Y. — IBM is adopting the Phonemail voice messaging system from Rolm Corp. of Santa Clara, Calif. Rolm has also announced a new version of Phonemail to serve companies that do not have Rolm private branch exchange or Centrex systems.

IBM said it will combine with Rolm in marketing Phonemail and IBM's other messaging products. IBM added that it will no longer actively market the audio distribution system, its existing voice messaging system, in the U.S. It will, however, provide central service support for ADS through 1986.

FRAMINGHAM, Mass. — The microwave systems market will approach $500 million by 1989, according to *Microwave Market*, a report published by International Data Corp.'s Communications Industry Research program. The report stated the 1989 figure will be double the 1984 market of $250 million and will experience a growth rate of 16% annually, spurred by trends toward private networks, compatibility with other transmission alternatives and technological advancements. By 1989, the study said, the private carrier segment will be 42% of the total communications market.

Further information is available from International Data Corp., 5 Speen St., Framingham, Mass. 01701.

PARSIPPANY, N.J. — Deregulation has been mostly or extremely beneficial to their industry, their companies and their customers, according to almost half of top-level executives surveyed in a recent research study by Trinet, Inc., Parsippany, N.J., and the Gallup Organization, Princeton, N.J.

Of the executives surveyed from the communications side, 49% of respondents said deregulation was beneficial to their industry, 47% said it was beneficial to their company and 34% said it was beneficial to their customers. The report indicated the low communications customer figure of 34% was a result of customer confusion and "upheaval" in the industry as a result of the AT&T divestiture. For further information contact Trinet, Inc., 9 Campus Drive, Parsippany, N.J. 07950.

DALLAS — Common carriers should start developing business plans for marketing integrated services digital network (ISDN) services, according to Al Boschulte, vice-president of Pacific Bell, San Francisco, Calif. Speaking at a recent International Communications Association meeting of telecommunications managers, Boschulte stressed that involvement of sophisticated users in the evolution of ISDN is crucial for assuring widespread operating efficiencies.

Market demand for ISDN will revolve around issues such as customers controlling their own networks, transmission predictability, an integrated features package and cost-efficient pricing, Boschulte added.

ROCHESTER, N.Y. — The Eastman Kodak Co. will enter the fiber-optics market through its newly formed Lamdek Fiber Optics division.

Lamdek will initially market a "high-precision field-installable" connector and related products for single-mode optical fiber. The company said the connector utilizes aspheric glass lenses to expand the optical fiber light beam, providing what Lamdek claims to be a high-quality durable connection between single-mode fibers.

Kodak said the fiber-optic connector will be available in the U.S. and Canada by the end of 1985, followed by its introduction into some international markets by late 1986. Citing industry analysts, Lamdek said the fiber-optics communications market in the U.S. is expected to grow to nearly $2 billion by 1990, the market for connectors alone accounting for nearly $200 million of that figure.

RESTON, Va. — A new annual conference on telecommunications and end-user computing has been announced by the National Computer Conference Board. Called NCC-Telecommunications, the show will first be held Sept. 8-10, 1986, at the Philadelphia Civic Center. It will be sponsored by the American Federation of Information Processing Societies, Inc. (Afips).

Spokesmen for NCC-Telecommunications said the new show will include technical sessions and professional development seminars combined with a full exhibit program representing major manufacturers of advanced integrated technologies and telecommunications products and services. For further information write Afips, 1899 Preston White Drive, Reston, Va. 22091.

INVEST IN THE BEST

By Stan Kolodziej

orporate executives are taking a hard look at the micros in their offices, and what they're seeing is the result of several years of high-rolling buying practices. What's more, not only have these micros grown more expensive, they've also been utilized less than management first anticipated. To meet end-user demand and to utilize these micros better, management information systems departments are searching for ways to bring more corporate data to the micro. As a result, micro-to-mainframe link vendors are being kept very busy.

The micro-to-mainframe link has been both a buzzword and a subject of speculation for some time now. Why so much controversy? One reason is that micro-to-mainframe products can be confusing. Simple on the surface, these products in fact can become a cat's cradle of hardware, software, communications and file conversion levels.

The most common mistake users make is assuming a micro-to-mainframe product is some plug-in panacea that will instantly merge micro and mainframe into a completely integrated computer system. Not so. Micro-to-mainframe products can be as simple as the basic conversion of mainframe data to Ascii format and slow (300 bit/sec) asynchronous transmission to a personal computer emulating a terminal. It can also be as complex as a real-time transaction processing system employing mainframe software, specialized controllers, expensive protocol conversion software and long-distance full-duplex communications at 19.2K bit/sec.

Another common mistake is the assumption that when data from the mainframe has been transferred to the micro, it can be handled like any other data on the microcomputer. Some users have

Rumor has it you're moving up to T1.

been surprised that a file transferred from an IBM machine running Vsam cannot, without difficulty, be loaded into a spreadsheet program written for PC-DOS and the IBM PC. Data must first be converted into proper file format.

For micro-to-mainframe links to work properly, the user should be aware that three areas have to be addressed:

• The actual method used to connect the micro to the mainframe.

• The communications method for transferring data.

• The actual conversion process used to get the data into a workable format on the micro.

The micro-to-mainframe connection can be either through a direct physical link such as hardwiring with a coaxial cable or through a modem and telephone hookup.

The communications method for transferring data, however, is not so straightforward. Communications software can lie in the firmware of a personal computer's expansion board, can be loaded from floppy disks or can be resident on the host mainframe. Such software allows a personal computer to handle the specific communications protocols given by the host mainframe. Speed is important. Some communications protocol converters can only handle transmission speeds of 1,200 or 2,400 bit/sec. For most batch or casual micro-to-mainframe processing, this speed is adequate for downloading data. Real-time transactional processing, however, needs something more like 9,600 bit/sec and up.

The third link in the micro-to-mainframe chain, the process used to convert data into a workable format, is the most important. The evolution of multivendor computer installations has helped create entire niche industries of protocol conversion products.

As is true of so many other areas of the computer industry, protocol conversion is an IBM-driven market. Perhaps the oldest and still largest market for converters involves IBM 3270 terminal emulation, followed a distant second by the market for DEC VT 100 terminal emulators.

Terminal emulators are the fast food of the micro-to-mainframe industry: They are mass produced, and they seem to be everywhere. Today's market for terminal emulators centers primarily on making an IBM PC act like or emulate an IBM 3270 for communicating with one of the large installed bases of IBM mainframes.

Terminal emulation in its simplest guise consists of using utility software, hardware expansion boards or a combination of both in such a way that the microcomputer is made to act like a terminal. By "fooling" the mainframe, the emulated terminal can instruct the host to present information to the terminal following protocols established by the host systems software. In other words, the two can talk in the same language. Terminal emulators have one major drawback, however; when the terminal and host are in session, that's all the terminal can do. The emulating micro cannot actually process incoming data until talks have been broken off.

Two of the most popular emulation boards are the Irma board from Digital Communications, Inc. (DCI), Norcross, Ga., and the Blue Lynx from Techland Systems, Inc., New York, N.Y. Both boards retail in the $1,000 range.

Most emulation board products offer only basic micro-to-mainframe functionality. Because the micro becomes a dumb terminal during emulation, it cannot be used for local functions until it has been disconnected from the host. Users who want to process mainframe files are finding they must follow the path many corporate users are taking: They first develop programs to extract the necessary information from the large mainframe files and then input the data into personal computer software formats such as the document interchange format (DIF). DIF, developed jointly by the U.S. Department of the Navy and the National Bureau of Standards, has been adopted by several major word processing vendors as the standard for transferring text between different WP systems.

Although many are similar, no two emulation board products are alike. The Blue Lynx board handles standard functions such as conversion to Ascii and local storage of 3270 files, but it also comes bundled with a utility software program that runs on the IBM PC and converts Ascii files into applications software formats such as Lotus Development Corp.'s 1-2-3, Ashton-Tate's Dbase II and the DIF standard.

Terminal emulators are not just for microcomputers. Before micros, terminal-to-terminal emulation (turning a Wang OIS terminal into an IBM 3270, for example) was and still is good business.

So-called independent micro-to-mainframe links are also big business. These products, which generally consist of software running on the mainframe or the micro, are usually produced by smaller companies unaffiliated with specific mainframe hardware or software products. Most of these software links require — but do not usually include — communications hardware such as the Irma or Blue Lynx boards. In addition to file format conversion to DIF, Ascii or other file formats on the personal computer, these links also usually offer some sort of security feature, either in the form of a data dictionary or an interface to the security already in the mainframe. Where these products excel, however, is in protocol conversion.

Software-driven links can involve cost savings because no additional hardware is required. But those savings could be offset by the cost of multiple asynchronous ports on the host as well as by the potential increase in host memory requirement.

One example of an independent software link comes from Linkware Corp. of Waltham, Mass. Linkware recently introduced a series of file conversion products that link various popular personal computers with DEC VAX and IBM mainframes. Other examples of software links are Tempus Link from Micro Tempus, Montreal, and that company's recently introduced Tempus Data, the latter being mainframe software allowing PC users to select and extract data from IBM mainframe data management software access methods such as Vsam, Isam, Qsam and IDMS.

These products are more sophisticated than simple terminal emulators, and their price tags reflect that fact. Linkware's prices range from $6,000 up; the Micro Tempus line ranges from $7,000 to $12,000; and more advanced mainframe-based links, such as PC Link from McCormack & Dodge of Natick, Mass., can run well over $30,000. For the extra price you can expect to get enhancements such as advanced security features, uploading into an IBM mainframe data format and full on-line Help and documentation.

The most popular type of independent link is hardware-driven. A link of this type replaces the host controller (usually an IBM 3274 or 3276) with a hardware product that attaches directly to asynchronous terminals. The controller-emulation function of the protocol converter responds to polls from the host, collects the received blocks of data and then performs code conversion. The controller also emulates an IBM terminal by accepting keystrokes from the terminal keyboard and then interprets the characters according to the data editing rules of the 3278 terminal.

Another hardware link method is disk-to-disk conversion. Disk to disk does not depend entirely on a communications link; instead, all of its data protocol conversion is accomplished within a self-contained unit. A major vendor in this area is Altertext, Inc. The $15,000 Altertext System II is about the size of a microcomputer and features a 12-in. monitor, a keyboard, up to six asynchronous and/or bisynchronous communications ports and four 8-in. and 5¼-in. floppy disk drives. Disk-to-disk software transfers information directly from one type of disk to another. The system translates information from one disk into A-Code — Altertext's central code set controlling the two-way exchanges — and from A-Code to the target system's format.

The most common complaint generally heard about protocol converters is the lack of performance, resulting in delayed response times. The burden of handling the host protocol and at the same time handling several terminals can make some hardware converters (especially those with single processors) drag their feet.

One of the fastest growing areas of micro-to-mainframe links concerns tapping into IBM's popular Distributed Office Support System (Disoss), which resides on an IBM MVS mainframe and helps IBM's office systems exchange documents. A number of third-party vendors are making a career of providing interfaces between the Disoss architecture and the products of various office automation vendors such as NBI, Wang, Xerox Corp. and Data General. Soft-Switch, Inc. of King of Prussia, Pa., was one of the first companies to bring such a product to market when it introduced its Soft-Switch Disoss link.

From these rather specialized micro-to-mainframe products, some vendors are beginning to join forces to provide a more integrated solution to customers. In the past few months, joint venture and marketing agreements among some vendors have led to some interesting micro-to-mainframe offerings. One example is the agreement between mainframe software vendor Cullinet Software, Inc. of Westwood, Mass., and DCI. Under this

arrangement, Cullinet produced its Information Database link software to handle communications links with DCI's popular Irma emulation boards. Cullinet's Goldengate PC integrated software package has also been equipped with the ability to enter mainframe extraction requests in a spreadsheet cell.

Compared with other computer markets, the micro-to-mainframe product market is tiny, but it looks forward to steady if not spectacular growth. U.S. revenues from the combined categories of general purpose communications software, dedicated terminal emulation products and intelligent/integrated links (including the revenue derived from the mainframe software content of the links) reached nearly $60 million in 1984, according to estimates from Natick, Mass.-based Venture Development Corp. This figure will reach $400 million by 1990, the research firm said, despite continuing confusion on the part of users toward the many types and technologies in the micro-to-mainframe area.

If IBM begins selling near what it predicted for its PC Networks, an area sure to heat up is a link between IBM's SNA mainframe environment and its PC Network.

Helping with revenues is a small subindustry that is starting to provide gateways between local-area networks and mainframes. Such links are new, largely because users of local-area networks — especially the newer PC nets — are still busy trying to figure out what to do with them. For those apparently lucky enough to have solved this problem, a few PC local-area net/mainframe products are now waiting.

Most of these local-area network/mainframe gateways employ some sort of file server or controller to handle data distribution and protocol conversion between the mainframe and the local net.

The Network Data Mover (NDM) and Network Access Services (NAS) products from The System Center in San Mateo, Calif., provide links between Corvus Systems' Omninet local-area networks and IBM mainframes, utilizing Systems Network Architecture (SNA) protocols. NAS resides on the local net gateway and gives IBM SNA access to any applications running on the PCs. NAS software is bundled into the gateway, and the combined product sells for about $9,000. NDM is an application program that moves files from one processor to another. NDM is actually two products: NDM/MVS for mainframes and NDM/PC for the local-area network.

Another gateway product, Virtual Networking System (Vines), was introduced by Banyan Systems, Inc. of Westboro, Mass. Vines centers around a 32-bit, Unix processor functioning as a network server, data dictionary, protocol converter and communications gateway. The front end of Vines supports a variety of personal computers and local nets (up to a total of four local nets simultaneously, including Ethernet, Omninet, Applenet and the IBM PC Network).

The back end of the processor communicates with host computers and other Banyan servers connected to other remote or local-area networks. The back end provides access to host applications, files and electronic mail through terminal emulation. Streettalk, the system's security software, is bundled into the system.

Other gateway products are available from Intel Corp. of Santa Clara, Calif., with its Intel Database Information System (Idis) featuring a local processor with software to access mainframe data bases and software to support local processing; and from Interlan, Inc. of Westford, Mass., whose NTS10 provides protocol conversion from and to users on an Ethernet network and IBM hosts (though no SNA links are provided).

Another area sure to heat up (if IBM can begin selling near what it originally predicted for its PC Networks) is a link between IBM's SNA mainframe environment and its PC Network. IBM has begun shipping its PC Network/SNA 3270 Emulation Program and has also announced a Series 1 PC Connect that allows the Series 1 minicomputer to act as a gateway between a PC Network and a mainframe running SNA. One of the few other SNA/PC Network links is from California Network Systems of Milpitas, Calif. That company's PC Network/SNA gateway software package, like IBM's, is available at $375 per user. California Network Systems, however, claims it offers a clearer migration path toward an eventual support of 48 concurrent sessions and does not, unlike the IBM product, require a dedicated PC as a gateway. At this stage, other PC network companies are keeping watch. This is a fledgling market. If IBM's SNA gateway begins to sell in volume, however, you can be sure those companies will soon jump in with its own better SNA mousetrap.

Kolodziej is a senior writer at Computerworld Focus.

IBM's LOCAL-NET POLICY: WHEN WILL IT SURFACE?

IBM's local-area network announcements send ripples through the industry each time they appear in the press. What is the strategy behind these seemingly disparate network pieces? Is there a strategy?

BY BRIAN JEFFERY

Are we all clear on IBM's local-area network strategy? There's the token ring, which will be available in 1986 or 1987 if it's not introduced in 1985. It's the strategic product everyone is waiting for, although it's going to be unpleasantly expensive and fits in more with the Systems Network Architecture (SNA) 3270 world than anywhere else. It runs on the IBM Cabling System, which consists of five — or possibly seven — types of cable, and it has something to do with the Rolm Corp. CBX II, or possibly it doesn't. It will support virtually all of the IBM product line, but not right away.

Then there's the PC Network, which IBM announced in three versions: a 72-device configuration available through IBM and distributors; a 255-device configuration, which IBM won't sell; and a custom configuration supporting several thousand devices, but IBM won't sell that either. PC Network supports Personal Computers and the Series/1, but, although the PC Network is aimed at corporate departments, it doesn't support the System/36, IBM's much-vaunted "departmental system."

IBM's working with Sytek, Inc., (broadband commitment) and Ungermann-Bass, Inc., (Ethernet commitment) but it's not supporting broadband or baseband coax for the token ring.

IBM is committed to the PC Network for attaching PCs in small groups, but IBM sales forces will also peddle Cluster Kit (the local-area network IBM said wasn't a local-area network); Corvus Systems, Inc.'s Omninet; Nestar Systems, Inc.'s Plan; and Orchid Technology, Inc.'s PC-Net — assuming they're not instead pushing a low-end System/36.

If this sounds confusing, it is. The main problem is IBM has been developing, describing and even introducing local-area networks for years without a single central plan. Only in June 1985 was a single unit formed to coordinate product and marketing directions, and only recently has IBM had anything that can reasonably be described as a local-area network strategy.

As is so often the case with IBM, strategy for local-area networks has been a case of piecing together a set of products developed by different IBM units with little or no coordination with the others, using different technologies and approaches, all incompatible. The situation is reminiscent of the confused office automation direction pattern that resulted when different IBM divisions peddled different office systems in the late 1970s and early 1980s.

The story goes something like this. In the beginning was the token ring. In the late 1970s, IBM got rather worried about

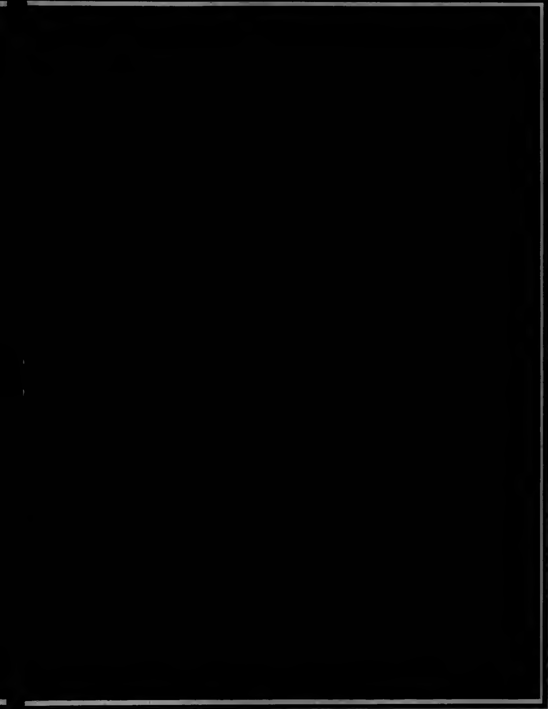


PHOTO ©19[illegible] ED [illegible]

something called Ethernet, which was getting a very good press. The IBM problem was felt to be one of reacting to this Ethernet threat with a product that would incorporate local-area network technology while preserving the basic IBM host-based hierarchy. A solution of sorts was found in a token-passing ring that had been developed at the company's research and development laboratory in Zurich. In its original form, the token ring was an extension of the 8100 Series loop architecture and had the advantage of being SNA-based and hierarchical.

Then the trouble started. IBM had a bad time with its development partners. Mitel, Inc. failed to deliver on high-end digital private branch exchange (PBX) technology; Texas Instruments, Inc. failed to deliver on very large-scale integration (VLSI) interfaces; and later problems developed with Rolm, Mitel's replacement. After publishing a barrage of papers and descriptions of the token ring — which naturally created the impression that it was imminent — IBM announced in April 1984 that, although the token ring was still two to three years away, users could have the wires now. Timing problems hindered attempts by IBM to tie the token ring system into SNA networking, and the five-chip set for the local-area network interface is still too expensive to compete effectively.

For several years, the token ring project was the joke of IBM. Then Big Blue staged a notable recovery. It wasn't so much that technical problems had been resolved, because they hadn't — they still haven't. Rather, IBM corporate management did some hard thinking in 1984 and decided that, whatever its faults, the token ring was a useful part of the SNA scenario. It would significantly contribute to SNA usage and, as any end user will tell you, SNA usage contributes significantly to IBM revenue streams.

Enter the PC Network, sometime in 1982. The PC Network was codeveloped with Sytek, the Mountain View, Calif.-based broadband local-area network vendor. PC Network was a project of IBM's Entry Systems. In those days, Entry Systems was regarded as a high-flying entrepreneurial outfit, and IBM corporate management was inclined to let it go its own way. Entry Systems had great ambitions for the PC Network. Not only would it let IBM move in on the market for PC local-area nets — an area where vendors like Corvus and Nestar were making the running — but the capacity and modularity of broadband coax would provide a new and more efficient method for large end users to hook PCs to hosts. PCs would be used as file servers, gateways and network management systems. At least that was the plan.

As the system neared completion, the fur started to fly inside IBM. IBM's Communication Products Division (CPD) objected to having the PC Network compete with the token ring. During 1984 Entry Systems' popularity inside IBM began to slide, and IBM corporate management put the brakes on. The result was a compromise: PC Network would be introduced only as a 72-device system and would be pitched by IBM only as a PC local-area network. This was scarcely an efficient utilization of the PC Network technology, which could easily support upwards of 200 devices (at least one PC Network in Boca Raton, Fla., happily supports more than 220 devices). The token ring was, however, moving back into popularity. By year-end 1984, it had reestablished itself as the focus of IBM local net strategy. Delays in delivering the PC Network interface boards got the system off to a bad start early in 1985. Then IBM hindered it further by saddling it with the elderly Series/1 as a file server and began to pitch combinations of the S/36 minicomputer and PCs as, effectively, an alternative for departmental automation and future components of the token ring scenario. A sad fate for what could have been an interesting product.

In 1984, IBM decided the token ring was a useful part of the SNA scenario. It would significantly contribute to SNA usage and SNA usage contributes significantly to IBM revenue streams.

Cluster Kit, introduced in February 1984 as a low-end 256K bit/sec CSMA/CD star for PC clusters, was also from Entry Systems and seems to have been aimed at organizations like small businesses, corporate departments and high schools. Cluster Kit never enjoyed much of a commitment from IBM and, when it became clear the PC Network was going to be positioned as a low-end product (supporting up to 72 devices compared with Cluster Kit's 64), the system was quietly "forgotten to death" by IBM.

The Industrial Network turned up as an official IBM product in August 1984. It grew out of IBM's involvement with General Motors Corp.'s Manufacturing Automation Protocol (MAP) program and is essentially identical with the MAP standard. It was adopted by the IBM Industrial Systems group, later re-formed as Manufacturing Systems Products out of Boca Raton, Fla. The group inside IBM successfully argued that there was no way they could offer the other IBM

More Answers from CXI.

PCOX is all you need to turn your IRMA board into a 3270 PC.

Its full name is the PCOX™/3270 PC Upgrade (that's pronounced "peacocks").

But you'll pronounce it "terrific."

First of all, it's available today. Not next week, not next month. Now.

Second, it costs just $395. And since it upgrades the IRMA™ board you already have, you can protect your investment. And still get the IBM™ 3270 PC capability you really want.

Third, you can be sure this software's reliable because we've been shipping it for more than a year in our own PCOX/3270 PC.

Finally, like all PCOX products, the PCOX/3270 PC Upgrade is backed by our proven track record in micro-to-mainframe connectivity. Which you'll be hearing more about in this series.

But back to the PCOX/3270 PC Upgrade. For immediate delivery call (800) 225-PCOX. In California, (415) 424-0700. Or write CXI, Inc., 3606 West Bayshore Road, Palo Alto, CA 94303, Telex: 821945.

And turn the IRMA board you have into the 3270 PC you want.

CXI

We don't have all the answers, just more of them.

local-area networks for factory use and they should join the MAP bandwagon.

As early as 1982, Ethernet support seems to have been targeted by IBM as a requirement, and Santa Clara, Calif.-based Ungermann-Bass has been developing an Ethernet gateway for IBM to the token ring. But IBM is more than a little reluctant to be seen backing Ethernet. Such backing could cause people to install Ethernets rather than token rings, and IBM will doubtless wait until the token ring is up and running before so much as breathing the word Ethernet.

The 3270 PC Communications System was mentioned by IBM in August 1984, at the time PC Network was launched. The system was vaguely described as one that allows peer-to-peer communications, file-sharing and peripheral-sharing by 3270 PCs. This doesn't seem to exist, at least not in the form pitched by IBM. In practice, it looks like a 3274-based solution supported as a local token ring configuration or over point-to-point 3270 coax and handling a variety of devices under 3270 protocols. The new IBM high-end 3274 model clearly goes with it. IBM's description of this system as supporting primarily 3270 PCs seems to be an attempt to prevent users from thinking that because it wasn't supported on PC Network, IBM wasn't backing it. IBM is backing it — not selling many, perhaps, but certainly backing it.

The various third-party products sold by IBM (the Corvus Omninet and Orchid PC-Net as cologo products, or the Nestar Plan under a cooperative marketing agreement) seem to have been adopted primarily as stopgaps until appropriate IBM solutions became available.

All these maneuvers can be seen in one of two ways: either IBM has made a clever move to sell multiple solutions for different applications and thereby bracket the market (that's the way IBM tells it) or IBM is making an improvised attempt to pull a bunch of disparate and incompatible products together into some semblance of a scenario (which is what has actually happened).

Some major problems arise for end users thinking of going the IBM local-area net route or at least waiting to see what IBM's local-net scenario looks like before making commitments. Not the least is that any kind of coherent IBM scenario is still several years out. The much publicized token ring looks as though it will make an initial appearance this year, but in a partial form and with limited availability. The interface cost is still high, and IBM is likely to stall full token ring availability until it can lower the cost of the token ring VLSI chip set to a more attractive level. This means a probable wait of at least another year before the token ring begins to resemble a final product.

PC Network's status also contributes to the confusion. The product has undergone at least a change in positioning, with the Series/1 now being pushed as a file server. PC Network was also recently transferred from its home at Entry Systems to a new unit IBM set up at Raleigh, N.C., to handle product strategy for all IBM local-net systems. There will probably be further changes, notably in integrating PC Network into the token ring environment. With the token ring taking priority, PC Network will likely remain crippled at the 72-device level. Sytek makes larger configurations of the system available but doesn't push them very strongly, and IBM isn't talking much about them. In addition, IBM seems to be planning to support Ethernet, but isn't talking about it.

All this activity suggests a certain caution for those who are looking at IBM local-area network solutions. The token ring and 3274-based solutions fit primarily into the SNA 3270 world; indeed, IBM has described the token ring as being primarily a subset of SNA implemented at the Data Link level. It may appeal to those with heavy SNA 3270 investments, perhaps, but scarcely qualifies as a general-purpose local-area network, and end users who aren't already deep into SNA may find it not worth waiting for.

PC Network could be a good product, but it's not clear IBM will allow it to be one. PC Network could be crippled further to protect the token ring. It would be a good candidate for attaching PCs and other devices in Ascii environments, but IBM is edging it into the SNA world.

Of the other IBM products, Industrial Network is merely an IBM implementation of MAP and more credible vendors with greater factory experience exist for this type of solution. Cluster Kit is dead in the water and certainly not guaranteed a future. The various third-party PC local nets marketed by IBM could be dropped at any time by the IBM direct sales forces. And, finally, for Ethernet support, there are also better candidates than IBM.

The bottom line seems to be that if you're waiting for IBM, don't. IBM's local net portfolio consists of a bunch of disparate and incompatible products, which the company has only recently gotten around to sorting out. Its key strategic product, the token ring, is a specialized system designed for SNA environments and 3270 device bases; and IBM shows no signs of bringing in the kind of general-purpose, modular, multivendor local net most of the market wants.

As an alternative, you could wait for IBM to present its definitive scenario, but you may wait a long time and you may not like it when it finally arrives. ‡

Jeffery is director of research for International Technology Corp. in Palo Alto, Calif.

Has AT&T Got a Deal For *You*...

Always in the forefront of technology, AT&T is now pushing integrated systems digital networks. When will ISDN become a reality, and what will they mean to your operation?

By H. Paris Burstyn

Since divestiture, the new AT&T has taken its lumps in unregulated markets. Current word has it that the new AT&T is a technological also-ran and that its computer technology and line of computers are too late into the field to make any difference. This philosophy discounts two important facts: AT&T invented the transistor that started the computer revolution, and its 3B line of computers forms an integral part of the world's most sophisticated and most reliable telecommunications network. What AT&T really lacks is not technology, but the ability to sell these systems into a commercial environment.

AT&T's true strength lies in its communications orientation and its increasing ability to interconnect devices from a wide variety of vendors. Although many businesses consider the ability to interconnect different computers a high priority, few are actually in a position to use that facility. In some cases, therefore, an AT&T weakness may stem from its technology's having outstripped its customers' needs.

This technology/application imbalance may also account for the softness in the personal computer market: Personal computer users are not using today's machines to their fullest potential; they are waiting to buy new ones, thereby accounting for the market slowdown.

As customer needs and new markets grow, other companies will develop comparable technology to challenge AT&T, but it is more than likely AT&T will set the pace for intervendor communications. By stressing communications over computers, AT&T's computer product line may never become a core business — a strategy that plays to AT&T's traditional strength. But when one of its communications network customers needs to expand computing facilities, AT&T will be able

to supply new hardware compatible with the customer's installed machines. Even if AT&T does not acquire or form a joint venture with a computer manufacturer, as has recently been speculated, the company's current line is serviceable enough to fulfill the role of secondary supplier.

Although some AT&T products may be solutions looking for problems, competitors quickly respond to any move AT&T makes and rush to emulate communications products. In communications technology, AT&T leads the pack.

Nevertheless, AT&T has had some major setbacks. Net 1000 has yet to make a substantial contribution to company revenues — despite innumerable evolutionary steps and name changes. The company is also conspicuously absent from the public electronic mail business. AT&T's slow starts in these arenas make sense, however, when put in market perspective.

Net 1000, a sophisticated time-sharing network, made its debut just as the entire remote computing services market began to slip in the face of competition from distributed data processing. Competitive ventures, although more successful than Net 1000, have not turned in stellar performances. For example, IBM's Information Network accounts for only a small percentage of the DP giant's sales, and General Electric Information Services Co., the market's leader, recently laid off more than 400 employees.

Industry rumors abound regarding AT&T's pending entry into the electronic mail market. The company's caution is well considered because AT&T would have to bring some special characteristics to any system it introduced to the market. It must set itself apart from MCI Communications Corp.'s Mail and Western Union, Inc.'s Easylink if it is to avoid the also-ran label.

If it does bring a sophisticated electronic mail service to the market, AT&T runs the risk of bringing a too-sophisticated product to a market where even simple systems have yet to earn any substantive profits.

If AT&T were to enter the public electronic mail market, it would have to deliver a traditional electronic mail service (such as GTE Telenet Communication Corp.'s Telemail or ITT's Dialcom) combined with hard-copy capabilities of MCI Mail and Western Union's Easylink. That service alone, however, would not be enough; it would have to add an applications level — adding value to, and setting itself apart from, basic services readily available from other providers.

A likely strategy could see AT&T linking electronic mail service to a Net 1000-like computing service. This tactic would provide users with automated access to data base management and DP functions. Early this year, AT&T announced plans to deliver central office equipment necessary to support the first commercial integrated services digital network (ISDN) to Ameritech (the regional holding company that provides local telephone service to Illinois and neighboring states) for service trials in the fourth quarter 1986. Shortly after that announcement, virtually every major vendor of central office switches from around the world hustled to announce comparable equipment and to line up test sites for their equipment. Similarly, when AT&T announced Software Defined Network Service, other long-distance carriers — known as other common carriers — quickly announced comparable services.

Software defined networks (SDN), or virtual private networks, provide a stepping stone on the road to ISDN. SDN take advantage of the constantly increasing capacity of the public switched telephone network and the intelligence of new digital switches to provide private network availability without the cost of leasing private lines. Instead of leasing private lines, customers that now make heavy use of private-line and Wats services can take advantage of software that resides in network switches to program the public network to meet specific point-to-point and point-to-multipoint communications requirements.

Virtual private networks allow customers with heavy communications needs to create their own networks. Each customer's network routing functions will be contained in network switches where specialized hardware and software will allow customers to call other virtual private network locations, off-network locations on that carrier's switched network and interconnected private networks.

In such virtual private networks, transmission facilities are dynamically allocated on an as-needed basis, instead of being physically dedicated to a particular customer on a full-time basis. AT&T Communications, United Telecom Computer Group, MCI, Satellite Business Systems and Western Union have announced intentions to provide such service.

When AT&T filed with the Federal Communications Commission to begin service by July, the other common carriers and some regional operating companies petitioned the FCC to reject or suspend the proposed AT&T tariff. Early in June, the FCC suspended the AT&T Communications tariff; this action will delay the company's beta test for as long as five months — the length of time allowed by FCC statute. In effect, the delay allows AT&T's competitors to get their products ready for market.

AT&T's technology offers network planners an advantage in facilities they will need. They won't have to plan for additional room to house extra equipment, and the AT&T switch could be more reliable because it requires fewer cabling connections to other equipment.

To provide virtual private network services, carriers use two different approaches. For the most part, the other common carriers take advantage of their switches' functions to create an independent dialing plan for each customer. That dialing plan is distributed throughout the network at each switch that will be involved in the customer's software-defined network.

To do this, memory in each switch is partitioned to accommodate a separate dialing plan for each company. The company identity is carried from switch to switch to maintain the individual dialing plan. When configurational changes are required (by company reorganizations, consolidations and so on), network changes are implemented by modifying routing information at each switch.

AT&T employs a different architecture that leverages the common channel signaling capability of its long-distance network. AT&T will maintain its customers' specialized dialing plans in a centralized data base rather than distribute them throughout the network. AT&T's common channel signaling technology is not available to other common carriers, so when customers require a configurational change, they must do it at every switch. Common channel signaling allows AT&T to make one change at the central data base.

AT&T's relatively advanced technology will allow it to provide virtual private networking more efficiently than its competition can, but it won't prohibit other common carriers from delivering similar service. Other common carriers will test and commercially offer their software-defined networks before or at the same time AT&T will. Nevertheless, AT&T was the first to announce it, and then competitors jumped on the bandwagon.

Software-defined networks will allow users to combine a range of communications services into a single, integrated service, which will give them greater onsite control of their network. In this way, SDN resemble ISDN; AT&T notes it has designed SDN as a precursor to ISDN.

Against this background, the availability of virtual private networks (from all carriers) will put pressure on local telephone operating companies to offer virtual local connections to match the long-distance virtual network. Such links would allow customers to have dedicated access to virtual networks without having physical facilities devoted to their exclusive use. Local service offerings are a key part of AT&T's strategy to sell the No. 5 Electronic Switching System (5ESS) central office switch to local operating companies.

AT&T's 5ESS is the cornerstone of its ISDN and Universal Information Service strategy. Although ITT's System 12 is considered a more advanced central office switch, ITT has had trouble manufacturing System 12 and is behind in its shipment schedule around the world. In addition, System 12 is not compatible with the telecommunications network in the U.S. and ITT is currently working to adapt it to domestic standards. This leaves AT&T's 5ESS and Northern Telecom, Inc.'s DMS line of digital switches as the main competitors in the U.S. central office market.

According to AT&T, 5ESS is designed to incorporate most ISDN features in one primary processing unit. Northern Telecom's DMS requires peripheral devices to provide similar ISDN capabilities. Northern Telecom announced ISDN for the DMS about two weeks after AT&T announced functions for 5ESS. AT&T's technology offers network planners an advantage in facilities they will need. They won't have to plan for additional room to house extra equipment, and the AT&T switch could be more reliable because it requires fewer cabling connections to other equipment.

The general concept of ISDN has it functioning as easily and as invisibly as today's telephone network system. It will allow people and their computers to talk to any other person or computer over a network that can store, transport and deliver any combination of voices and data at any time from any place.

ISDN are the stuff of every equipment and service suppliers' dreams. ISDN will bring these companies new sources of revenue as they provide customers with a wide range of new services.

Today, interconnecting all those people and systems is a technical nightmare; as a result, many people involved with the U.S. telecommunications industry believe ISDN will remain a dream — at least into the next century. But for the U.S. market, AT&T seems to have the technological advantage over the other central office switch manufacturers.

While a few of the major central office switch manufacturers have sold auxiliary equipment (such as trailer-mounted portable switches and signal transfer point equipment) that will perform some ISDN functions for operating telephone companies, AT&T and Northern Telecom will probably take even shares of 90% of the 1985 market (with GTE capturing the remainder by selling to its own operating companies).

In 1986, AT&T can be expected to increase its share of that market to 70%, which it held prior to 1984. (In 1984, Northern Telecom won the majority of contracts because its digital switch was ready and AT&T's was not.)

In 1986, Ameritech plans to test the nation's first ISDN in Chicago. Initial ISDN service will provide simultaneous voice and data transmission capabilities over the same wire.

Today customers can send both voice and data over the same telephone line, but they can't send both signals at the same time. If customers want to send large amounts of data at high speeds, they must order lines that have been specially conditioned to handle the data. ISDN allows simultaneous transmission and obviates the need for conditioning arrangements.

As its technology evolves, AT&T sees the advent of Universal Information Services, which it likens to its earlier goal of universal telephone service. Universal Information Services will allow telephone companies to give customers the ability to custom configure their telephone system and data communications network without buying specialized equipment; they will use the intelligence that resides in the telephone company's central office. Just as it uses 5ESS for ISDN products, AT&T plans to use 5ESS as the core for the broad range of products composing Universal Information Services.

Universal Information Services will give users the ability to call up the services they need when they need them and to pay for them as they use them. Although ISDN integrates voice and data storage and transmission services, Universal Information Services gives customers the ability to change the network's configuration at will as well as handle image transmission (teleconferencing).

Only a fraction of ISDN-type services are available today, and they require making special arrangements with value-added carriers — companies that allow customers' computers to talk to other computers regardless of the computer manufacturer; some also provide access to public data bases, remote computer services and electronic mail. Value-added carriers lease lines for long-distance and local telephone companies (some build their own communications networks), add computerized functions to them and then resell them to their customers.

This data transmission facility, available over so called value-added — or overlay — networks, is only one piece of ISDN, and it isn't integrated with voice or image transmission services. Lumping all these features into one integrated network will make it very easy for users to perform any communications applications they want.

Demand for integrated services already exists. Many large companies subscribe to overlay networks such as Telenet and Tymnet. But customers subscribing to these services must pay monthly membership fees as well as minimum usage and per-use charges.

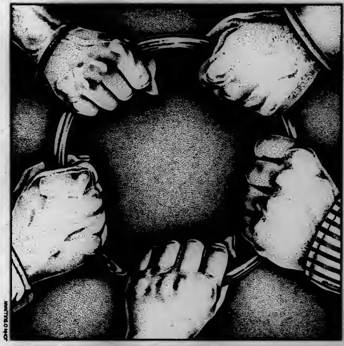
AT&T sells 5ESS to telephone operating companies and claims its hardware and software technology make the switch attractive to these potential customers. The attraction is that local telephone companies will be able to increase the number of functions a 5ESS delivers by implementing new software, not installing new hardware.

To a local telephone company, new services mean more revenues. These services, available through software, are inexpensive to acquire, but very attractive to users.

Pricing services to entice users to apply them will increase network usage levels. Because new services can be installed incrementally and at relatively low cost, ISDN technology translates into improved margins for the telephone company and improved service for customers.

AT&T will drive competitors to keep pace and further enhance services and margins; its technology development will drive the evolution of new applications to take advantage of these services.

Burstyn is a staff member of World Telecommunications Information Program, Arthur D. Little Decision Resources in Cambridge, Mass., and is editor and product manager of its monthly publication, Telescope.



Token-Passing Ring Networks

Local-area networks don't just happen; the good ones are the result of a lot of careful planning. Before you commit your company to a local net, take a look at token-passing technology — it may be worth the effort.

By Edwin G. Brohm

Local-area networks have developed in response to problems that have cropped up in the area of data communications. Like computers, these nets have different characteristics, specifications and applications. Unlike computers, however, their selection often fails to receive the hours of careful attention data processing managers devote to finding the best choice for their applications.

One choice for a local-area network is the token-passing star-shaped ring, which is one of the most reliable, fault-tolerant and easily maintained local nets available. Token-passing star-shaped ring nets solve several problems encountered with other types of networks, including those employing carrier-sense multiple access with collision detection (CSMA/CD) such as Ethernet and token-passing bus architecture. To determine a network's superiority, a potential buyer should pay careful attention to four key networking attributes: reliability, ease of maintenance, ease of expansion and network performance.

Reliability: Reliability is a major cost factor in selecting a local-area network; a network that lasts longer without breakdown will obviously cost less to own than one that fails weekly.

To be reliable, a network must be distributed. Pure star-shaped networks that employ a central processing node are susceptible to total network downtime from this single point of failure. In a star-shaped ring, wire centers, which connect nodes to the ring, allow the ring to be distributed. If any point in the network fails, other nodes

on the local-area network will not be affected. In addition, in the event of a cable break, the ring automatically partitions into smaller subrings that continue to function.

Networks based on token-passing bus architecture that employ CATV components must be swept periodically and tuned if they are to function properly. In contrast, the passive wiring system used by token rings is based upon the wire center and contains no power supply or logic.

The only active components of the token ring are relays, which are specified for millions of operations. As an example of reliability, the mean time between failures of a wire center is measured in years. The token ring employs a more distributed topology and will last longer without failure, increasing reliability.

Maintenance: If a failure does occur on a network, a quick and easy method of locating the problem should exist. A good deal of network downtime is often spent trying to find where the fault occurred. A properly designed token ring network will minimize the time needed to make repairs.

Token rings have a maintenance advantage over bus networks because token rings can be self-diagnosing. For example, an LED indicator positioned on the passive wire center can indicate which station is malfunctioning. If the LED is designed into a central panel, locating breaks in a system will be even easier. Repairs or replacement of a faulty node can be made immediately. And, because the token ring local net bypasses the failed node, the network continues to operate during repairs.

Another method that incorporates self-diagnostics allows the token ring network to indicate the node or point between nodes where the problem is occurring. A network monitor could interrogate the host controllers containing the error and allow the operator to locate the failure quickly and to repair the network.

Expansion: In a token ring network, new computing devices can simply be connected to a wire center. In comparison, if new computers or workstations are added to a CATV-based network, the system will eventually have to be realigned, and modems and amplifiers may have to be adjusted to compensate for network growth.

Token ring local-area networks generally operate using a single frequency and therefore do not require rebalancing. Stations can be added to a network without frequency adjustments. In addition, token rings do not contain amplifiers or splitters.

The cable in a bus network will have to be physically tapped to add nodes if a network is expanded. This process, boring small holes into the cable, cleaning with tweezers and clamping with a tap may be cumbersome. In a star-shaped ring, users simply plug nodes into a wire center and the process is more conducive to prewiring.

The token ring also offers another advantage, flexibility in network media. In a factory, for example, inexpensive shielded twisted-pair wiring may be sufficient for most areas; in an electrically noisy area, fiber-optic cable may be used as part of the same network.

Performance: Although many networks claim high signal rates, the best measure of a network's performance is its data throughput. A CSMA/CD throughput may actually be much lower than its optimum data rate for two reasons. First, transmission can be slowed or halted when two or more stations send data at the same time; second, there is often a large amount of overhead per data packet, such as message preambles and host addresses.

The collision problems of CSMA/CD local-area networks are not shared by token ring nets, and their overhead per packet is low. In addition, token passing local-area networks allow orderly transmission between stations. As the token is sent along the network, each station has the option of sending data or passing the token on to the next station, which means that each station has equal and predictable access to the network. No opportunity for collisions or garbled transmissions exists. CSMA/CD networks have a potential for delayed or aborted transmissions when multiple users contend for access to the network.

An increasing number of vendors and users are looking toward token ring local-area networks as the new standard. IBM, both in its Statements of Direction and in an extensive advertising campaign, has announced its support for token ring local-area networks and is promoting its new cabling system, which will support token ring networks. According to IBM, token ring networks are reliable and offer greater predictability of performance and greater network management capability.

As data bases grow and become accessible by multiple departments, accuracy and speed become major factors in data transmission. Token ring local-area networks can offer more speed and accuracy than CSMA/CD-type networks. In addition, token rings have proven to be more reliable, easily maintained and expandable for future growth.

In the final analysis, the user must choose a local-area network according to specific applications. Selecting data communications equipment is just as important as finding the correct computers. Reliability, maintainability, fault tolerance, flexibility and speed should be some of the criteria for selecting a local-area network.

Brohm is product marketing manager of Proteon, Inc. in Natick, Mass.

"...Fiber Optics..."

Fiber-optic cable is no longer just the domain of large telecommunications companies. Fiber optics solves problems ranging from overcrowded conduits to data integrity, and DP managers are now jumping on the "speed-of-light" bandwagon.

By Lee White

The year was 1983 and Terry Rosga, manager of network services for the city of Dallas, had a big problem. The city's tremendous growth and its progressive attitude toward automation were being stifled by yesterday's technology.

Rosga investigated many avenues for solutions, not only to the problems the city was facing in 1983 but to those it might encounter for the rest of the 20th century. He looked at high-speed digital lines, but ruled them out because of the better than 6,000-feet distances. He turned down the possibility of AT&T's Dataphone Digital Service because of the nearly prohibitive expense involved. Microwave communication was tossed out, primarily because security couldn't be assured. And all the alternatives were susceptible to weather glitches. Fiber optics looked like the best choice for Dallas, especially because there would be no month-to-month recurring costs after the fiber was purchased.

Rosga recalled how bad things were in 1983; for example, at that time, police called in information from the beat, and clerical personnel entered it. From that entry point, data would go over one of several leased lines to a central file and be sent to any number of places — from the jail facility at one end of town to the criminal justice court facilities at the other end of town. Response time was critical, but the seconds became minutes. In addition, leased lines were costing the city a great deal of money.

Complicating this problem were others, including printing of the next day's court docket. Although a high-speed printer was used for this task, police department personnel who didn't understand how the printer worked would go into the "supposedly" locked room and push buttons in an attempt to achieve higher speeds.

Before Rosga presented his recommendations to the director of network services and the city manager, he decided he had better make sure fiber optics was the right solution for Dallas. He called in Phalo/O.S.D Corp. and Fibronics International, Inc., for a system test. The Fibronics demonstration was successful. With the groundwork laid by Rosga and his team, his employers not only gave the initial go-ahead, but granted some money for research and development. With this imprimatur, Rosga was able to investigate the best method for installing fiber and found that, because of a 15-year-old franchise statement, the city would be able to install fiber through conduits owned by Southwestern Bell Telephone Co.

The next step was to write exact specifications and go out for bid.

The city received several responses, with Fibronics a low bidder at $155,000 for cable and boxes. "Bell was trying to do it, but didn't have the black box — and it was the time of the split-up. They wanted $1.3 million just for the cable and five years' maintenance on the cable. We would never own it, and Bell would have to get the boxes from somebody else," Rosga said.

Rosga hired Dallas' traffic signal employees to carry out the installation procedure — lay cable, actually pulling it through manholes. It took 17 workers four weekends to accomplish the task, running two different routes for redundancy. Each cable consisted of 12 fibers; each fiber could handle 32 terminals.

The project for the city of Dallas took two years from inception through implementation. Rosga, who is now a systems engineer with General Datacomm Industries, Inc., estimated the installed fiber-optic cable would indeed meet Dallas' needs through the end of the century.

The end of the century seems like a long time indeed in a technological field where longevity is measured in five-year blocks of time and where the management information systems (MIS) director's fondest wish is to install a machine that's not 50% obsolete by the time it's up and running. But spokesmen for the fiber-optics industry talk in terms of cable that will last forever.

J. Morris Weinberg, chairman of Fibronics International, Inc., in Hyannis, Mass., stated that, although fiber optics isn't doing everything today, it will; he added that 99% of the world's networks today are done with coaxial cable. Some people are saying, "Wait a second, slow down. Isn't there a better way of connecting all those assets together than having lots and lots of cables, each of which has limited bandwidth capacity?" Weinberg said that those people are only the tip of the iceberg.

Perhaps one reason more data processing people have not gone the fiber-optics route is the newness of the field. Brian O'Brien Sr. developed image-transmitting bundles of fibers in the 1950s at American Optical Co. in Southbridge, Mass. In 1963, Elias Snitser, also at American Optical, suggested optical fibers could transmit communications signals. It was not until 1970, however, when Robert D. Maurer, Donald B. Keck and Peter C. Schultz at Corning Glass Works, Inc., were able to produce a fiber that had acceptable attenuation rates of 17 decibels per kilometer. It was another seven years before both the Bell System and General Telephone and Electronics put prototype fiber-optic systems into service carrying live telephone traffic.

Charles DeLuca, vice-president of sales and marketing for the Spectran Corp. in Sturbridge, Mass., characterized the eastern corridor as Silica Valley. That area includes many fiber-optic companies in the Sturbridge/Southbridge, Mass., area; Corning Glass Works in Corning, N.Y.; AT&T Bell Labs in New Jersey; and Sperry Corp. in Pennsylvania.

DeLuca came up with the same phrase Fibronics International's Weinberg used — "tip of the iceberg" — to describe the state of fiber optics as it relates to data technology. He stated that fiber optics' usefulness is limited only by engineers' creativity. "The future is as bright as engineers perceive it can be. The whole technology has risen out of the curiosity stage and into the real world. It's no more wishful thinking. What were perceived notions five years ago have become reality today because the components are here and can move right into production."

Journeys into outer space put Artel Communications Corp. in Worcester, Mass., into fiber optics in a big way. During the first space shuttle, the National Aeronautics and Space Administration encountered problems with television cables radiating and affecting its tracking systems. According to Dave Monk, Artel's director of marketing, Tadeusz Witkowicz, president of the fledgling company, went to CBS and offered to build fiber cables and fiber-optic modems that didn't radiate and took up far less space than traditional cable. CBS accepted Witkowicz's offer, and Artel Communications was off and running.

Fiber-optic technology has had an impressive albeit slow acceptance. The biggest forward leap in legitimizing the use of fiber optics for data communications, however, was IBM's announcement of its Sierra series, which uses optical fiber to extend controllers, DeLuca said. MIS directors who have been burned in the past by adopting a here-today-gone-tomorrow technology should begin to feel more comfortable. "Now IBM has the lead. When Big Blue has taken the lead, that's it." DeLuca explained, adding, "We haven't seen the beginning of it yet. It's just mind-boggling."

What exactly is fiber-optic cable and how does it differ from the more commonplace coaxial cable or twisted-pair technology? The only real difference is the method by which information is passed through the cable. Over copper wire, digital information is changed to analog signals and back again; over fiber-optic cable, the digital signal is turned into light.

One of the biggest selling points for fiber-optic cable is security. Fiber-optic cable transmissions cannot be compromised or intercepted without actual physical access into the cable. This bug-free characteristic has made fiber optics the cable of choice for military installations.

Another plus for fiber optics is its compactness. A fiber-optic cable as wide in diameter as a pencil may contain as many as 144 optical fibers, each fiber equal in capacity to a large coaxial cable plus a ribbon data cable. Size becomes a critical factor in installations where ceilings and floors are already clogged with coaxial cable or when underground conduits are full to overflowing with cable.

Perhaps the biggest advantage to the DP world is the integrity of signals passed over fiber-optic cable. Bandwidth of fiber-optic systems remains high, regardless of length, thereby eliminating signal degradation and poor picture quality.

A big disadvantage of coaxial cable and satellite transmission is electrical interference from power lines, other cables, lightning and other weather problems and radio-frequency sources. Fiber-optic cables are immune to all forms of interference.

But perhaps the biggest advantage to the DP world is integrity of signals passed over fiber-optic cable. The high-frequency response, or bandwidth, of coaxial cable decreases with increased length. High-frequency signals are lost by coaxial cable over distance and a high-resolution picture degrades. Bandwidth of fiber-optic systems remains high, regardless of length, thereby eliminating signal degradation and poor picture quality. These factors become especially critical for organizations considering cabling for graphics terminals or computer-aided design and manufacturing terminals.

According to Richard Cerny, chairman and chief executive officer of Artel, a fiber-optic company whose niche is the graphics market, the bandwidth for graphics used to be 20 to 30 MHz. Recent trends, however, have been to increase resolution and refresh rate, both of which significantly increase the bandwidth. "With a 1,280 by 1,024 picture that's going at 60 MHz refresh rate, you have a 120-MHz bandwidth. That means coaxial cables have to be shorter and shorter. That's going in the reverse direction from what people want," Cerny said.

Even after taking into account the many advantages to fiber-optic cabling systems, price has been the most obvious stumbling block to widespread implementation. At a cost per cable foot of approximately $1.25 for coax, compared with the $3.12 per foot Roaga paid for Dallas' fiber-optic cable, the difference certainly appears to approach 300%. The cable installed for Dallas, however, was 12-fiber cable that could support 12 times 32 terminals, or 384 terminals, with multiplexers that might cost $500 each, at each end. Although coaxial cable can also support multiple terminals with the addition of multiplexers, it does not support nearly as many of them and it does not support them nearly as well. It also has none of the known advantages of fiber-optic cable.

Why then, given the choice, would anyone choose coaxial cable over fiber-optic cable? One reason might be the enormity of a failure, should one occur. When terminals are hooked to controllers via coaxial cable, should the cable fail, one tube goes dark. In the case of a fiber-optic highway in which fibers are connecting dozens of terminals to a mainframe via multiplexers on each end, a failure is a very big deal. According to Weinberg, however, the problem is very seldom in the fiber. "Once the cable is in, I don't think I can recall one [cable break] out of the thousands of networks we've installed," Weinberg said. Rather, he explained, the problem is in the high-speed electronics end, "and that's why we work so hard to preclude that from happening with tremendous overdesign, robust systems, burn-in and all the other things we do."

But according to Artel's Monk, the roadblock to overcome is lack of awareness of the extensive capabilities of fiber optics. The industry has no spokesman, he explained, and, although the subject is well-covered in the engineering design publications, it has not received wide attention in the computer-related literature. "Most of the companies in the business are small like us, and we don't have education departments. We aren't on the chicken circuit thumping the tub for fiber optics every 10 minutes. We don't do an extensive job of educating people. We could do a better job, and it wouldn't cost us much," Monk added.

Until the time fiber-optic education filters down to the rank and file of DP

management, use of the new technology will continue to be primarily the domain of telecommunications firms and government areas that need high security networks.

Companies constructing new buildings, however, are finding fiber optics is the most cost-effective and efficient way to go. Dave Stein, staff manager of business customer equipment for Southwestern Bell Telephone Co. in St. Louis, Mo., was involved in the decision-making process for data communications networks when his company built its new 42-story headquarters.

The choice of fiber optics was dictated in part by constraints that were in place, one of which was the inability to use the ceilings to pull ordinary coaxial cable. "The ceilings were air plenums and if we had put cables in the ceilings, they would have had to be Teflon-coated; the polyvinyl chloride jackets on normal cables put off chlorine gas if there is a fire around it," Stein explained. The Teflon-coated cable was prohibitively expensive and difficult to get.

Stein also wanted to get away from cable because of his experiences with it in the buildings Southwestern Bell had rented in downtown St. Louis. He found that when a cable was put in, it was never pulled out or reused, even if a terminal was moved. "They just pull a new cable and pretty soon you've got some places where you can see the ceiling literally falling down because of the weight of the cables," Stein said.

Stein and his team chose a fiber-optic network for the entire Southwestern Bell building, the tallest in the state of Missouri, figuring that once a good fiber-optic distribution system for data was installed, cable would never again have to be pulled. Even when the company changes computer systems or terminals, Stein enthused, "all we'll ever have to do is change the type of optical-to-electrical converters that go on the end of the fiber cable."

Southwestern Bell took a novel approach to its network. There is a horizontal floor distribution system with 11 nodes. Four fibers go out to each node from a wire closet, and each node location consists of eight workstations. The four fibers are brought out at the center of a workstation cluster, and at that point the optical-to-electrical converters are attached. Southwestern Bell then leads terminals off that converter with conventional cable.

The other part of their network is the vertical distribution system. With this network, eight fibers from each floor return to the 22nd floor, which is the heart of the system. From the 22nd floor, floors can be patched to one another. The horizontal network consists of 45.8 miles of fiber and the vertical net has 46.3 miles, for a total of 92.1 miles.

Of interest is the fact that Southwestern Bell purchased their cable from Belden Corp., even though AT&T is a cable manufacturer. Stein didn't find this unusual at all. "We divested from AT&T. We put out the bid to several different

Southwestern Bell chose a fiber-optic net for the entire building, figuring that once a good fiber-optic distribution system for data was installed, cable would never again have to be pulled.

manufacturers and took the lowest bid that met the spec," he explained.

Stein's experience with AT&T should not lead anyone to believe the communications giant doesn't have a mighty strong foothold in the fiber-optic market. According to David Stonehill, vice-provost for computing at the University of Pennsylvania, AT&T is installing $8 million worth of fiber-optic cable and electronics to connect 130 campus buildings and interconnect parts of the AT&T Integrated Services Network (ISN) at the University of Pennsylvania (Penn). Although the University of Pittsburgh, Carnegie-Mellon University, Cornell University and Johns-Hopkins University all have fiber optics, Stonehill believes Penn is the largest installation to date in the ISN realm.

The enormity of the Penn installation is underscored by the fact that no "digging" has been necessary. "Some far-sighted person in 1973 put in a number of data tunnels," Stonehill said. "We have manhole covers saying 'U of Penn Data Communications,' along with steam and telephone."

There is little question the amount of money being spent by organizations such as the University of Pennsylvania will result in cost-savings in the future. Stonehill hopes to save money, but certainly sees cost-avoidance as a by-product. "The thing is, if communications connections keep moving along as they are — about 30% more each year — this will save a bundle in the next five to seven years."

White is a senior writer at Computerworld Focus.

FOCUS ON PLANNING

Local-Area Network Installation: Plan Now Or Pay Later

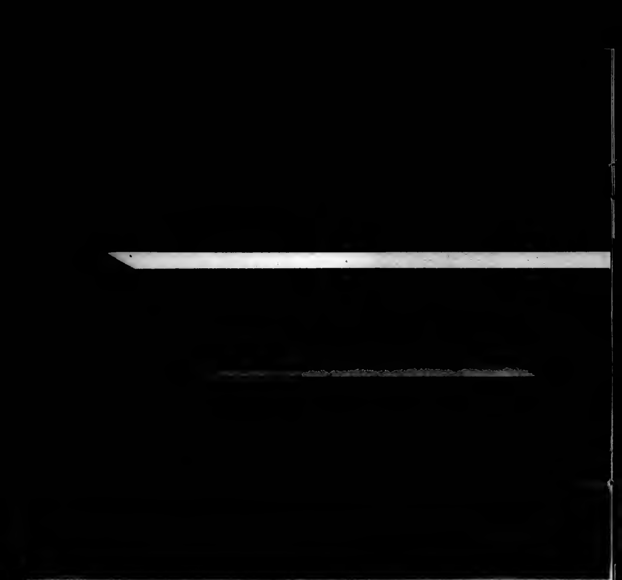
By Edward Cooper

A chorus of ayes could be raised in support of the statement that local-area networks offer many advantages. Modify that statement to include a description of how these networks should be installed, however, and that consensus would disappear, especially among management information systems managers. MIS managers who want to avoid headaches later will take time to be sure their planning has been wise and well-informed. The cabling design and installation a vendor provides will have a major impact on how smoothly a company's project proceeds, whether the specific local-area network technology is broadband, baseband or private branch exchange.

The local-area network market now contains more than 200 local-area network vendors, many of whom offer more than one installation option, and companies should familiarise themselves with the trade-offs and cost benefits associated with network installation. If the MIS manager makes the right choices in the beginning, the company will not only save time and money but will also ensure that future local-area net expansion will be easier. Someone within the organization should become very familiar with the capabilities of vendors, the technological details involved in local-area nets and the company's networking requirements. This knowledge will not only be useful in picking a vendor, but will also be crucial in assessing the best installation method.

A company has three installation options: It can install the network itself; it can use third-party vendors and hire consultants or contractors for certain aspects of installation; or it can have the network designed and installed by a vendor that offers a turnkey service. Because it demands a high degree of knowledge and involvement, the first option, the user-installed network, is probably the least popular choice. It does, however, offer some advantages.

Before the request for proposal can be written, someone in MIS or elsewhere in the company must be well-versed in the technology; otherwise, there is no way of knowing what equipment should be purchased and from whom. Even if members of the staff are technically competent, the company will often have to augment the group with a specialist or two. A local-area network consultant should be retained to review design and



YOU'VE ALWAYS KNOWN WHAT YOU
UNTIL NOW, YOU JUST COULDN'T

It's easy to see what you get with a CASE Series 4000 modem. And just as easy to control. All it takes is one finger.

You can configure and test everything through a touch-sensitive front panel. Scroll in four directions through an LCD display that speaks back to you in plain English.

Add a DXM diagnostic card and turn your Series 4000 modem into a network management center. Now you can monitor, configure, option, control and test point-to-point or multidrop remote units, all from the front panel of one modem, at one site.

Through DXM's message exchange, you can even put your finger on the front of any other modem in your network, as if it were right there. Which eliminates costly phone calls to remote site operators.

Build a whole network of Series 4000 modems all by themselves. Or open that net-

USA CASE Communications Inc., Columbia, MD, *Telephone:* (301) 381-2300, *TLX:* 89-8347
UK & EUROPE World Headquarters: CASE, England, *Telephone:* 0923-58000, *TLX:* 923325

WANTED IN A NETWORKING MODEM. QUITE PUT YOUR FINGER ON IT.

work to all kinds of current, past and future CASE products, through the new CASE Series 5000 Network Management System.

It's what *future-proof data communications* is all about. And why CASE is already an international leader in the field.

Series 4000 comes in 2400, 4800, 9600 and 14,400 bps synchronous models, all with the same compact housing, all with more features than we could ever describe in one ad.

So find out more about the networking modem you've always wanted. Put your finger on the phone and call CASE, toll-free, at 800-422-2724, extension 421.

CASE
Future-Proof
Data Communications™

Canada CASE Communications Ltd., Ontario, *Telephone:* (416) 495-0333 **Australia** CASE Communication Systems Ltd., *Telephone:* (02) 451-6655, *TLX:* 72982 **Hong Kong** CASE Hong Kong, *TLX:* 86870

equipment specifications. System layout is a craft that relies on repeated trials and comparisons, rules-of-thumb and experience. Without this expertise, a novice will find it difficult to predict all the "oops factors."

A properly designed network has the major advantage of being able to be expanded more easily. When the initial design is created, a company should consider future applications, know the maximum geographical extent of the local-area network and do a thorough building survey.

After network architecture and topology have been determined, other key decisions include location of the network maintenance center, backbone design and level of redundancy within the network to ensure maximum reliability.

After the design has been completed, the funds allocated and the products ordered, an array of local-area network equipment will be drop-shipped to the company's door by the many different vendors.

The do-it-yourself method of installation will take longer and can be more problematic than other installations. Four months or more can pass before an average-size network is up and running.

Self-installation can cause upheaval within the company because in most cases personnel will not have had the experience of putting in a local-area network. Also, staff members who otherwise would be performing regular jobs will now be working on the local-area network project, which will put a burden on the rest of the staff.

Although some companies assume self-installation will cost less, this is untrue. The cost of the extensive time a staff spends in learning, designing, installing and maintaining the network should be considered a local-area network cost.

The advantages of the do-it-yourself option are that the company's data processing specialists will have more control over the network and be more self-sufficient in maintaining it. Also, during the long and complicated process of network design and installation, staff members will have had excellent on-the-job training in local-area network technology and operation. As a result, they will be better prepared to repair and expand the network.

Nevertheless, this installation option is now less popular than the other two options for several reasons. Purchasing many products from many local-area network equipment suppliers will cause confusion in the form of multiple purchase orders and a drawn-out purchasing cycle. MIS managers will be vying for resources within the company for each equipment purchase and subsequent installation. Finally, buying equipment at lower volumes can result in a more expensive local-area network.

Although some companies assume self-installation will cost less, this is untrue. The cost of the extensive time a staff spends in learning, designing, installing and maintaining the network should be considered a local-area network cost. Another handicap of user-installed local-area networks is that some time may elapse before they are operational. Many companies don't want to wait.

The second option — using third-party vendors — is a more popular choice than self-installation. When the third-party vendor choice is made, either the MIS department designs the network or the company hires design consultants. Equipment purchase becomes the company's responsibility, although some vendors will provide service during and after installation. In most cases, a contractor will be hired to install the transmission medium, which is usually coaxial cable.

As in the case of self-installation, this option works best if at least one staff member is knowledgeable about local-area network technology and the requirements of the network. This staff member's knowledge will make it easier to create the performance and design specifications and the acceptance criteria the cable consultant will need to install the transmission medium correctly.

Usually, the company purchasing agent confers with the contractor about performance and design specifications and acceptance criteria. The contractor will then get clarification on certain points, make recommendations and present a bid.

The final negotiated price can increase if something was forgotten or if complications occur with the job. Using third-party vendors is more demanding on a company's purchasing department because separate purchase orders must be budgeted, negotiated and drawn up for each consultant, contractor and supplier.

After the contractor installs the transmission cable, the company attaches its equipment to this transmission medium. Future communication requirements should have been taken into account during the initial planning; the network almost always needs to grow immediately. Most companies find that when a network is installed and people within the organization see its benefits, the demands for network expansion will surpass original expectations.

Putting in an average-size local-area network usually takes two months or more when the third-party vendor option is chosen. Installation is faster with this method than with self-installation. Less disruption occurs within the company because most personnel are still performing regular jobs. However, a certain amount of upheaval takes place when workmen and representatives from different contractors and vendors are on site.

In the case of the backbone system, the contractor usually includes a warranty with installation. The contractor can, however, also offer maintenance service under a separate contract. Most companies utilize this service because they do not want to maintain the transmission system themselves.

What happens if equipment problems develop? This fear constitutes one of the biggest drawbacks to the third-party vendor approach; various suppliers and consultants frequently indulge in finger-pointing exercises rather than quickly isolating problems in the local-area network. When a device breaks, the failure must be located, the defective unit replaced and the system returned to operation. Most vendors, understandably, want someone else to be responsible.

The third option — using a turnkey vendor — is quickly becoming the method chosen by many companies installing a network. A few local-area network vendors offer everything from initial network design to long-term maintenance as part of a single consolidated package. The turnkey vendor looks at a company's communications requirements, draws up a workable design that keeps future expansion in mind, installs the network and then trains staff in equipment use. Finally, this vendor will maintain the network.

One vendor does everything. This greatly simplifies purchase and approval cycles because only one purchase order is required. Unlike the second option, which uses multiple vendors and contractors, the choice of a turnkey vendor involves just one price quote, which includes everything involved in the local-area network. The customer is given a clear picture of the actual cost of a network.

Tracking all the costs — particularly time put in by staff members — is often difficult when a company installs its own network or hires contractors. At first glance, the price quoted by a turnkey local-area network vendor might seem much higher than the prices of the other available options. If a company tallies the entire expense of other installation methods, the cost of the turnkey approach will be about the same.

Putting in a system as complicated and expensive as a local-area network creates anxiety for those within the company responsible for it as well as among staff members in general. A proficient turnkey vendor will have asked all the right questions beforehand. The Murphy's Law syndrome that occurs with distressing regularity in network installation can usually be avoided.

Installing an average-size local-area network through a turnkey vendor takes about six weeks. Less internal disruption results than with any other method. Few company staff members are involved, and the vendor's well-trained installation crew is experienced in putting in cables and components smoothly.

Turnkey vendors also offer the advantage of taking singular responsibility for any problems with the network. Most MIS departments, which usually handle the company network, are chronically understaffed and being able to call just one vendor for problems or repairs is very convenient.

The disadvantage in going with a turnkey vendor is that sacrifices must be made in the area of response time should network problems occur. An outside vendor will never respond as quickly as well-trained, in-house technologists. Most vendors will allow a company to specify response times as part of the contract or will include an on-staff expert in the original deal.

Companies should be demanding as well as choosy when they select a vendor. They should think of today's needs as well as tomorrow's. Each vendor offers something different as does each installation method. Managers owe it to themselves and their companies to become aware of the costs and benefits and to decide what works best for their organizations. ‡

Cooper is director of product marketing at Sytek, Inc. in Mountain View, Calif. He is author of the book, Broadband Network Technology.

FOCUS ON PLANNING

Your SNA Network – Do You Manage It or Does It Manage You?

By Thomas W. McDonald

The communications network is the circulatory system of today's corporation. It is responsible for maintaining the flow of corporate information among all appendages and branches of an organization. A network that operates in degraded mode or totally fails causes repercussions that are felt throughout the corporation, all the way from customers through middle management to senior executives. Degraded network service translates directly into lost productivity. An unhealthy network means service-level objectives are not met, tasks are not completed on time, budgets are overrun and, finally, corporate business plans fail.

Maintaining the flow of corporate information, consistently and cost-effectively, through Systems Network Architecture (SNA) networks is essential. To accomplish this task, a properly implemented strategy of network management will fulfill two criteria. First, it will allow service-level targets of end-user response-time and network availability to be met in a confident, consistent and cost-effective manner. Second, it will allow the network manager to change posture from a reactionary pose of fire fighting to a more proactive stance of anticipation and planning. A key point is avoidance of crisis. When the problem exists, damage has already been done. When the user is experiencing the problem, it is too late.

A critical step is identifying any transaction rate, activity or service that could cause available capacity of individual network resources to be surpassed to the extent that the network fails to meet its service-level targets. To accomplish this goal, the network manager must be in a position to evaluate the current network, optimize the performance of current network resources and plan for the integration of new users and services into the network.

The network manager who successfully implements this strategy will be able to determine when to provide additional service from the existing configuration and when it will become necessary or cost-effective to justify expenditure for additional resource.

The first activity necessary to implement a plan of network performance management is to produce network performance reports that allow the network manager to evaluate the utilization of the resources in the network. For example, information in

these reports would tell if a front-end processor is approaching a slowdown (buffer depletion) condition or if a line utilization is reaching a critical level. A review of some simple performance reports will point out underutilized resources and resources pushed to capacity.

The reduction of network measurement data is the foundation of a successful strategy of network performance management. The first step is the reduction of performance measurement data.

The most obvious gauge of how well the network is performing is response time measurement. Response time information can be gathered by hardware or software measurements. Almost all software response time monitors work by implementing a trace in Vtam (the communications access method in the host processor). This trace will time stamp a message at five points. Reduction of this trace data shows the time the message spent in Vtam, in the host environment and network time. This data is collected and reduced in batch mode. Reports that are produced tell the response time as experienced by the end user. This trace can be initiated on a user and/or application basis. This method allows accurate information on end-user response time to be gathered and breaks the response time into major components of host and network time; however, this method also has two major drawbacks.

The first drawback is the requirement that a definite response be requested by the application. Without the implementation of definite response mode, no network response time information can be produced. In most cases, the implementation of definite response puts only a minimal overhead on the network.

The second drawback is the overhead in running the trace, storing accumulated trace data and reducing that data. Although processor overhead is usually acceptable during the running of the trace, space for storing continuous trace data for large networks is considered a problem at some sites. This second drawback can be overcome by running the trace selectively. If it is feasible to implement definite response mode in the application and to control storage resource, accurate end-to-end response time information can be produced by the use of a software monitor.

If response time measurements that can be viewed in a truly real-time fashion are needed, a hardware monitor is the tool required. If you need immediate knowledge of what response time end users are receiving at any moment, the delay incurred in the reduction and processing of software monitor trace data will be unacceptable.

By interacting with the network at the digital interface between the front-end processor and the modem, the hardware monitor can remain transparent to the network while it monitors all messages going across the lines to which it is attached. It breaks response time into major components: inbound and outbound transmission time, poll wait and host time.

A hardware monitor, however, also has drawbacks. The first is cost. To completely monitor a medium-size to large site, purchase costs can easily climb into the $250,000 to $500,000 range. Those who are willing to look at the network piecemeal will find that a less expensive approach is available. For example, for well under $10,000 a user could purchase a single line monitor that would tell the response time for all terminals active on a line as they access all applications. It would also break this response time information into its major components.

The second drawback occurs in both multiline and single-line configurations. Because the hardware monitor interfaces at the line side of the front-end processor, the amount of time it measures as the host delay is actually a combination of total time in the front-end processor and the host environment. For a hardware monitor, host time includes any time spent in the front-end processor due to outbound queuing at the line; any delay caused by insufficient buffers or cycles in the front-end processor; as well as any delay in the host processor, memory or I/O configuration and so on.

Likewise, network time is not broken into components of local-line time and internodal or backbone time. In most cases, this detail is insufficient for solving response time problems.

Without doubt, the hardware monitor is unsurpassed for accurate real-time data on end-user response time. For cases where the question is why response time is poor, however, the hardware monitor often offers incomplete answers. For those who have access to true host time figures or to a model of the network (for example, Best1/SNA), the host time can be broken out into front-end processor and true host time. A model will also break the network time into boundary time and intermediate backbone time.

Figure 1. Full-Duplex SDLC Line

There is a class of simpler hardware monitors — control unit or terminal monitors — which are less expensive and easier to implement than line monitors. They report total response time for users at a particular terminal or control unit, but do not break response time into component parts.

Although response time continues to be the most popular indicator of network performance, no simple inexpensive method allows continuous comprehensive response time information to be reported.

Other indicators of network performance do exist. Equally important data can be found in products that allow the determination of utilization of the major network resources. For example, IBM's measurement tool — Network Performance Analyser (NPA, now a subset of NPM) — allows the user to see utilization of the front-end processor as well as line and control unit utilization. When response time information is unavailable, a review of resource utilization will often point to the problem areas of the network as well as the overconfigured areas.

Successful completion of this first step — production of performance reports — allows the network manager to be alerted to potential problem areas in the network and to look at the balance between network cost and service. The network manager is able to make a gross approximation of where the network is overconfigured and where it is lacking resource. The network manager is able to weigh the dollar cost of existing hardware and software as well as personnel salaries against the service the network is providing.

After the baseline has been established, the second step is performance tuning and balancing. In this step, the network manager can optimise the service being delivered based on effective use of resources — to provide the best network service for the network dollars spent.

Whenever possible, tuning is chosen over adding resource when new users are added to an existing network or when new service is required. Tuning allows new users to be added or better service to be provided for existing users without spending any money.

The most obvious method of tuning is reconfiguring lines, control units or terminals. Configurational tuning simply means moving hardware and users into different physical arrangements. The user experiences a better level of service as more of the network resource is dedicated to him.

Another kind of tuning is software tuning. SNA is a cost-effective network architecture because it allows end users to share resources. The control unit resource is shared by the terminals, the line resource is shared by the control units and the front-end resource is shared by the lines. SNA has tuning parameters (PASSLIM, PACING, RUSIZES) that allow priorities to be set for service to individual users in the network.

Figure 1 on Page 39 shows a full-duplex synchronous data link control (SDLC) line with IBM 3274 control units in San Francisco (SFO) and Los Angeles (LAX), and a less active control unit in San Diego (SDO). Figure 2 shows response-times and line utilization for these 3270 users. The users are accessing IMS and CICS and receiving total response-times of about three seconds. (The inbound and outbound message sizes are approximately 40 bytes and 240 bytes for IMS and 30 bytes and 210 bytes for CICS.) From this performance report, the network manager knows the service-level objective — four seconds — is being met.

A short time later, the network manager receives complaints about response-time on the line. Again, a response-time report for that line is gathered. Figure 3 shows the new response-times. All users are experiencing a degradation in service. Upon closer inspection, the network manager discovers 3279 color graphics terminals have been added to the San Diego control unit. The graphics outbound message size is about 3,000 bytes. This work load has a serious impact on existing users. The large graphics messages are using up more than their share of the line and are blocking other users on the line.

How can service levels be restored their targets for all users or for as many users as possible? Figure 4 shows that after adjusting the PASSLIM value from seven to two for the graphics control unit (thereby prioritizing flow to LAX and SFO by allowing them seven frames per service and SDO only two), response-time for IMS and CICS can be brought back into a reasonable range. To provide low response-time to all users on this particular line, it would be necessary to add resource.

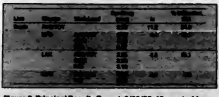


Figure 2. Principal Results Report, 6/30/85, 10 a.m. to 11 a.m.

Figure 3. Principal Results Report, 7/8/85, 10 a.m. to 11 a.m.

Figure 4. Principal Results Report, 7/8/85, 10 a.m. to 11 a.m.

By balancing and tuning network components, the network manager can control network service among users and optimize the balance between the amount of money spent on network resources and the service the network is delivering. The manager can determine when existing configurations can provide new service and when adding resource to provide new service is cost-justified.

Balancing and tuning the network is not without risk. Tuning as a way out of performance problems or a means to accommodate new users has the major advantage of no visible costs. However, a great risk is associated with this approach. Tuning data flow control parameters is not simple or predictable. Prioritizing and deprioritizing service can have adverse effects on network performance. A change that improves some users' service might have disastrous consequences to others.

Because the network manager is intent on crisis prevention — reacting to problems before they occur — network modeling is crucial. By modeling the proposed tuning changes before their implementation, the manager can predict the system-wide effects of the tuning change before implementing it.

In the example above, the risk-free way to implement change in PASSLIM is to model the change before the new PASSLIM is integrated into the NCP GEN and implementation takes place on the live network. Modeling shows any positive or adverse effects of changing the parameter, eliminates experimentation on the live network and plays a further role in performance management in the network planning phase.

Capacity planning is the third activity required to properly manage the performance of an SNA network. If consistent service levels are to be maintained and the corporation is to continue to meet its goals, crucial new network activities must be anticipated and, if necessary, appropriate compensatory action must be taken while time allows.

The heart of a successful capacity planning strategy is the modeling function. Modeling the network allows the network manager to assess the impact of new users, services, hardware or software before the change takes place.

In the tuning example above, if the proposed graphics users had been modeled before actual implementation in the network, no degradation in response-time would have occurred. There would have been no need for lost production or revenues or bad morale caused by poor response time experienced between the time of adding the new users and implementing the tuning solution.

When new users are added to an existing network, the network manager has the following three main concerns: What hardware (terminals, printers control units, lines) is required in the local and intermediate nodes to support the new users? Can the service-level objective be met with existing resources? Will the new users adversely affect the service of the current network users?

The network model will indicate which configuration of hardware and lines are appropriate for these users. This decision can have a great impact on network cost. For example, an IBM 3274 control unit can support up to 32 devices. Modeling results indicate the performance of different numbers of terminals per control unit. If 10 control units can service 200 terminals as well as 15 control units can, the network planner must be aware of this. A 3274 control unit purchase runs between $6,000 and $12,000. Significant amounts of money ride on these hardware decisions.

After the terminal/control-unit configuration is settled, the number of control units per line must be decided — the second area of configurational planning where the model plays an important role. The model will indicate the optimum number of control units that may share a communications line.

When the configurational question has been answered, the service-level concerns of new and existing users can be addressed. Modeling allows you to cost-effectively plan for the integration of new users and service to the network. It allows you to look at potential service-levels and costs associated with delivering those service levels. The crisis situation can be avoided.

Today's corporations call on the data communications network to deliver their lifeblood — information. The network manager plays a crucial role. Network performance can be directly translated into corporate performance. A network can be a consistent and dependable component of the corporate plan through the implementation of a strategy that employs measurement, tuning and planning and allows modeling to play a strategic role. ‡

McDonald is senior consultant for data communications, BGS Systems, Inc. in Waltham, Mass.

Life in the Fast Lane—Can Telecommunications Managers Keep Pace?

By Stan Kolodziej

Today's telecommunications manager lives life in the fast lane — at least in a corporate sense. The January 1984 divestiture of AT&T opened the flood gates to new communications products, technologies and vendors — all aiming their respective sales guns at beleaguered telecommunications managers who are running hard to keep up.

Telecommunications managers find their galaxy of communications suddenly part of a vast, complicated universe. Where there were once only analog, there is now digital; where there were only twisted-pair wiring, there is now cable, microwave, fiber optics and satellites; where computers and telephone exchanges were once apart, they are now being married; where tariffs were simple, they can now produce migraines.

Communications technology is leaping forward. T1, statistical multiplexers, network managers and computerized branch exchanges are part of the new telespeak. Local-area networks, hybrid private branch exchange (PBX)/local-area networks and PBX versus local-area networks remain controversial topics. Network standards are the next hot contention points: IBM's Systems Network Architecture (SNA) versus integrated services digital network, open systems interconnection versus SNA, broadband versus baseband and General Motors Corp.'s Manufacturing Automation Protocol versus everyone.

Telecommunications managers must keep pace simply because they have suddenly been thrust into the center of the telecommunications vortex. More is expected of the telecommunications manager because more is expected of telecommunications. As a result, perceptions of corporate telecommunications are changing.

According to Dan Muecke, vice-president of technology at Bankers Trust New York, "Telecommunications was once perceived as a cost control center with little business impact. Now it's recognized as an area where corporations can gain a direct competitive advantage."

Duane Heidell, vice-president, corporate telecommunications at Marriott Corp. in Washington, D.C., and president of the Dallas-based International Communications Association, said telecommunications management "is viewed not so much as a technical exercise now as it is a business management function."

Telecommunications in larger corporations is being reshaped to fit into the corporate cutting edge. Telecommunications is a strategic offensive weapon, no longer on the defensive.

Corporations have increased their telecommunications operating budgets on an average of 11% in 1985. New telecommunications employees are commanding up to $35,000 in starting salaries, with directors and managers culling $100,000 and beyond.

Ironically, all this new attention can create an identity crisis. Telecommunications is getting more room to flex its muscles, but sometimes it finds there is no audience. This is not surprising because senior executives have been nurtured on two decades of IBM-dominated data processing. Corporations have long accepted at face value the importance of DP. Not so with telecommunications. Perceptions of telecommunications as a cost-cutting role will take time to change. Until then, telecommunications managers have a selling job — to convince those controlling the purse strings that telecommunications deserves its new place in the sun.

"Telecommunications has been around longer than data processing, but the concept of data and data processing has always been easier for executives to understand and consider important," explained Mary Johnston, senior analyst at the Yankee Group, a market research firm in Boston. Telecommunications can, therefore, find itself at a disadvantage. Management information systems, a DP domain, has over time paved avenues of access to executive power structures in many large corporations.

Equipped with little boardroom clout or inroads to corporate power, telecommunications departments can find themselves in a dilemma: while new technologies increase the competitive importance of telecommunications, only a few telecommunications managers possess the corporate support that is required to transfer this power into tangible benefits for their own departments.

The benefits of technology can be further fickle. The thrust of the new communications technology focuses on integrating voice and data. Though traditional voice analog technology kept telecommunications a weaker corporate department, it also kept it separate and often autonomous. Digital data, however, forms the lifeblood of MIS. And, like an extension of some natural law, the greater the role digital technology plays in telecommunications, the greater the influence of MIS over telecommunications.

Though the sway of MIS over telecommunications was strengthening even before local-area networks and digital PBX came to the fore in the early 1980s, the divestiture of AT&T seems to have accelerated the process. In response to the confusing array of tariff rates and vendors, many corporate executives have decided to face uncertainty with a united front — usually in the form of a merger with MIS. Many telecommunications managers have found themselves in the paradoxical position of having increased prestige (and salaries), but decreased autonomy, often reporting to the MIS director or equivalent.

Another corporate tactic gaining ground is to keep telecommunications and MIS separate, but place them under an umbrella information group. As industry watcher Johnston pointed out, however, the supposed emphasis on separateness can be misleading. "Some companies," she said, "are saying they hold telecommunications on an equal footing with data processsing. They place the two under an umbrella organization, but typically the person in charge of the umbrella group is from MIS. There are a number of parallel organizations [from telecommunications and MIS] in the making, but it seems that MIS is taking the lead and getting more people at the top."

If this is the case, many corporations don't seem to mind. Muecke explained that a year ago at Bankers Trust, after both departments were merged under a new technology umbrella group, the telecommunications manager and the MIS director became "peers." They report to

the same executive vice-president, and things are working out nicely.

Harry Venable, director of telecommunications services at Celanese Corp., Charlotte, N.C., said although the telecommunications and management services (MIS) departments at Celanese report to the same vice-president, they are separate at the director's level. Venable stressed this has been in effect and working admirably for years.

At Shearson-American Express Corp. in New York, telecommunications and MIS were separate until a few years ago, when they were merged under the umbrella communications systems group. Andy Sokolov, senior vice-president, said, "Now that voice and data are using the same T1 systems and there is a good deal of joint coordination in effort and implementing [office] branches, it makes sense to combine these forces under an umbrella group." Sokolov reports directly to the executive vice-president of MIS.

In a recent poll conducted by The Conference Board, Inc., New York, the group found almost 40% of the companies responding had the MIS executive sharing responsibility for telecommunications planning with the telecommunications manager. The actual number, however, is generally agreed to be even higher.

Just as major technical forces such as T1 transmission seem to be bringing telecommunications and DP together, some smaller forces that are steadily growing in importance are pulling them apart. Many forms of bypass technology such as fiber optics, microwave transmission systems, satellite stations and teleconferencing are increasingly being used as ways of circumventing overburdened public telephone and packet-switched lines. As these new technologies gain ground, so does the influence of MIS.

"A lot of telecommunications products and services are now being marketed directly to data processing people," explained Jerome Lucas, president of Telestrategies, Inc., a McLean, Va., consulting firm. "In our case, we're seeing a lot of small-apertured satellite earth stations for two-way transmission being purchased directly by data processing people. The data processing people have a strong interest in things like satellite networks because it gives them total and complete control."

The pros and cons of having MIS gain more control of telecommunications are debatable. Telecommunications managers, however, do agree on two things: divestiture was good for the industry and there is pressure on telecommunications managers to expand their knowledge beyond the technical sphere.

Telecommunications managers do not wish to turn back the clock to predivestiture days. They treat the chaos of the year following AT&T's breakup as a necessary penalty to pay in the worthwhile transition to the more rewarding, albeit confusing, marketplace of competition and choice. "Where it once took a single call to get something done, it might take three or four now," Bill Coopman, manager of telecommunications at Deere & Co., Moline, Ill., explained. "In some cases there are more headaches, but when I look at today's products and services, the competitiveness and pricing structures, I get excited about it. I wouldn't want to go back."

In light of the rush of new vendors and

The pros and cons of having MIS gain more control of telecommunications are debatable, but telecommunications managers do agree on two things: Divestiture was good for the industry, and there is pressure on telecommunications managers to expand their knowledge beyond the technical sphere.

products following divestiture, users are stressing reliability and service as top selection criteria. Companies fear an industry shakeout and look to long-term vendor stability. As Jerry Marcone, assistant vice-president of telecommunications at Crum & Forster Corp., Morristown, N.J., put it, "You can save all the money in the world, but if you can't get a person to come in and give you dial tone, voice/data integration doesn't mean a heck of a lot."

Though it could be argued that such a situation breeds an overly conservative attitude on the part of corporate telecommunications users, the figures can show the opposite. A recent survey conducted by Newton-Evans Research Co., Inc., of Ellicott City, Md., found more than 50% of the respondents planned to be less reliant on AT&T for communications services by 1987. Only 9% thought they would make more extensive use of AT&T during the next few years. So much for

AT&T being the telecommunications life raft. If anything, it is fighting to retain a share of the telecommunications pie.

The flood of new technologies places the telecommunications manager at the hub of corporate life. Communications has become "sexy," and attractive, according to Kerry Overlan, director of corporate telecommunications at the United Brands Co., based in Boston. Career paths are opening wide. Telecommunications is now managerial as well as technical in scope. Many telecommunications managers are earning masters' degrees in business and degrees in finance on top of degrees in electrical engineering, programming and computer science. Many are learning the ins and outs of their businesses. Telecommunications managers no longer are expected to be just "techies." They have to know how all the pieces of an organization fit together and, more important, where telecommunications fits in. To do that, they also have to keep on top of current technology. "Telecommunications managers have to be more involved with the technology," Lucas said. "The day is past when the telecom manager relied very heavily on vendors to do analysis and understand the technology. Telecommunications managers are taking on more responsibilities in planning and operations. They just can't pass everything off on a management or maintenance contract."

In a recent speech, telecommunications consultant Richard Kuehn of RAK Associates, Cleveland, Ohio, said the era of system purchases to supplant rental costs is virtually gone for the telecommunications manager. The telecommunications manager, Kuehn stressed, must now compete within the organization for capital dollars that will provide a sufficient return on investment to justify their expenditure. Corporate production, distribution and other administrative areas will all be vying with telecommunications for scarce resource money. Telecommunications managers, like their colleagues in MIS, will have to know more than just communications; they will have to sell it to the top brass.

Muecke put it more bluntly: "Any telecommunications manager of any reasonable-size company who doesn't know financial management is saddled with a severe career disadvantage. You might not need an MBA, but you need to know financial analysis and be able to make presentations to senior management. If you can't do that, you have a problem."

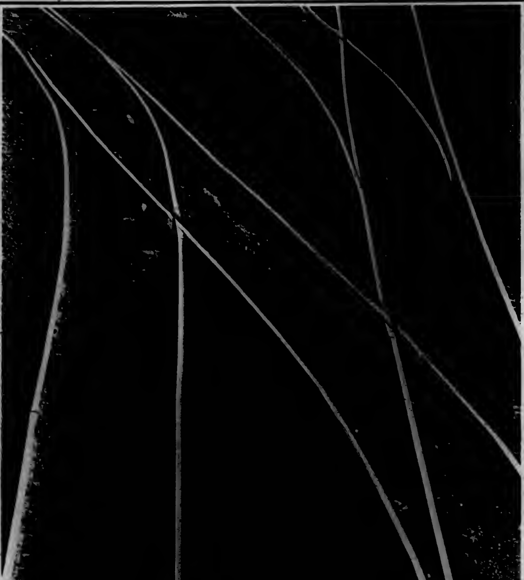
Bernie Kemple, central-region manager for Tymnet, Inc., in Dallas, has seen a dramatic change in telecommunications managers in the past few years. "We would call on people [to sell networking services] and there would only be a data processing or MIS manager," he explained. "Many companies did not even have telecommunications managers, and those that did were relatively naive in their technical knowledge of communications. Now, because of the dollar volumes of these telecommunications budgets, companies are hiring more educated, credentialed people, some with MBAs on top of technical degrees. In many cases, they are becoming peers of MIS managers."

Telecommunications is demanding more from personnel, but the supply of personnel to fill telecommunications is tight. Finding and keeping qualified telecommunications people is not easy. Among corporations, heavy competition in recruiting and head-hunting is heating up, causing salaries to spiral upward. The days are probably gone when telecommunications recruits could be gradually nurtured through on-the-job training. The acceptable learning curve is growing shorter. Companies want newcomers plugged in and quickly operable. Many companies now recruit directly from the few colleges and universities offering telecommunications courses and degrees. Those that cannot find adequate personnel from outside are recruiting from within their MIS ranks, accelerating in-house training.

As telecommunications in the large Fortune 500 companies becomes complex, specialization is necessary. Like the medical profession, telecommunications sees a growing number of specialists in tariffs, PBX, T1 systems, fiber optics and network management. Coopman, who has been in telecommunications for 17 years, explained, "Back when I started, you could be a jack-of-all-trades. Now you have to begin specializing in PBX systems, in network engineering and enhancements like teleconferencing, voice mail and electronic mail. We have an expression, 'Nothing is easy anymore.' "

Maybe not easy, but life in the fast lane does seem to be more agreeable to most telecommunications managers. "As I go to seminars, I find telecommunications managers are enjoying their jobs more . . . even the telephone companies are enjoying it more," Lucas said. "Everyone complains, it's confusing, we'll make mistakes, but it's a more fascinating business to be in."

Kolodziej is a senior writer at Computerworld Focus.



PATRICIA GROSS PHOTO STOCK, BOSTON

Packet Switching: What's Down the Line?

On March 1 the FCC opened the gates for the BOC to enter the packet-switching arena. That's both the good news and the bad news. New equipment, new services and new problems are arising as the players reposition in the market.

By Pamela Powers

Packet-switching has been widely promoted lately as a preferred method of transmission. Traditionally, the medium best served users that sent large amounts of asynchronous, bursty data over long distances. With improvements in technology, however, usage has evolved to encompass a variety of environments. This evolution is apparent in both sectors of the marketplace: the services sector, which includes value-added networks, and the equipment sector, which includes vendors of packet-switching nodes and packet assemblers/disassemblers.

Since the days when GTE's Telenet and Tymnet, Inc.'s Tymnet were the only players in the field, the value-added network marketplace has grown tremendously; an impressive array of fledgling vendors have now come to hawk their wares. At least 15 value-added networks of varying degrees of sophistication are currently available in the transport and manipulation of data. The veteran players retain the lion's share of the market; a large chunk of the remaining share is occupied — in descending order of penetration — by the following companies: United Computing Systems, Inc.'s Uninet; Compuserve, Inc.'s Compuserve; IBM's Information Network; ADP Network Services, Inc.'s Autonet; and AT&T Information Systems' Net 1000. (See Figure 1, Page 52.) Despite other companies' demonstrated enthusiasm for joining the fray, Tymnet and Telenet reaped profit from their ventures into the value-added net business only last year. With due respect for this caveat and the confused regulatory and competitive climate, vendors have adopted diversified approaches in order to attack niche markets.

The regulatory vagary the Federal Communications Commission (FCC) has promulgated in recent years is radically altering the texture of the value-added marketplace. On March 1, 1985, federal regulators authorized Bell operating companies' provision of asynchronous-to-X.25 protocol conversion, heralding the full-fledged entrance of Bell operating companies to the packet-switching arena. The decision enables Bell operating companies to offer asynchronous-to-X.25 conversion over their own public data networks rather than through a separate subsidiary. According to the FCC, the waiver will heighten the efficiency and availability of packet-switched services as well as contribute to the operating companies' revenues, thereby allowing cheaper local rates. This further relaxation of

the rules enables Bell operating companies to stick a large finger in the packet-switching pie.

The fear that lurks behind the ruling is cross-subsidization. In the event of local packet-switching, Bell operating company-to-Bell operating company links and/or inter-local access and transport area service would encroach upon the value-added network turf by eliminating a primary source of revenue for value-added networks — access charges from the local loop to the public data network.

Despite some doomsday prophecies and an air of uncertainty, the value-added networks market will continue to hold its own. Bell operating companies' participation in the marketplace will complement services available across the value-added networks.

The silver lining — and a factor that will have a more significant impact on the marketplace — is the role the Bell operating companies will play in extending value-added network service to previously untouched areas. This expansion into the local access and transport area will lure a new potential user base — small business and residential users.

In this incipient frenzy to keep their heads above water, the value-added networks are busily cleaning house. The following distinct trends have emerged:

- Increasing node intelligence. Micros have preempted minis as intelligent node processors, and protocol conversion capability is increasingly integrated into hardware, firmware and integrated chips.
- Increasing node accessibility. Value-added networks are evolving to hierarchical architectures utilizing smaller nodes in less concentrated areas and larger nodes in more heavily trafficked areas. This will permit greater geographic dispersion of the networks.
- Increasing applications specificity. More intelligence and the attempt to corner niche user markets is resulting in networks dedicated to specific applications.

Despite some doomsday prophecies and an air of uncertainty, the value-added networks market will continue to hold its own. Bell operating companies' participation in the marketplace will complement services available across the value-added networks.

Provided the FCC keeps a lid on anticompetitive behavior, the entrance of the operating companies should serve to open up new niches of potential business for value-added networks. In 1984, vendors reported earnings reflecting steady growth, with Telenet and Tymnet retaining positions at the top. The overall pattern suggests several lucrative years ahead with a five-year compound annual growth rate of 35% predicted, totaling to a year-end 1989 market of more than $1 billion.

Development of new private networks, upgrading for public nets, expansion of installed base and increased use of hybrid networks as carriage to the value-added networks all contributed to a healthy climate for vendors of packet-switching systems in 1984. Systems vendors are approaching high-volume businesses more aggressively; the swing to private networks is imminent. Government, banking, transportation, retail and manufacturing concerns all have immediate needs for efficient data transport and are becoming more willing to invest initial capital to ensure reliability later. In the interim, systems vendors continue to reap handsome profits from their installed bases, whose needs continue to grow.

Finally, carriers (especially the Bell operating companies) provide a hefty chunk of the yearly shipment revenues (particularly for Northern Telecom, Inc. and Databit/Siemens Corp.). These customers own vast amounts of backbone that require continual upgrading to support density of data traffic across lines. As switch offerings continue to improve and user needs expand correspondingly, systems vendors will enjoy some healthy profits. In 1984, shipments of nodes totaled $222 million, up from $105 million in 1983. The industry can be expected to achieve a 23% compound annual growth rate, culminating in $541 million in worldwide shipments in 1989.

The packet-switching equipment market is dominated by a few heavyweights, (with GTE Telenet, Tymnet, Northern Telecom, BBN Computer Corp. and M/A-Com, Inc., at the top, ranked in descending order of penetration), yet the U.S. harbors an enormous demand that allows for a steady infiltration of new players. The domestic market still sits at the beginning of the demand curve, such

that supply will most likely not surpass profitable bounds for years to come. Most corporations with heavy communications requirements are at the very least considering packet-switching as a viable option. Many of them are currently drawing up requests for proposals or negotiating contracts. This large base of potential users is where entrants will gain a toehold.

Entrants have found OEM arrangements to be a highly beneficial tactic. Credibility is easily gained by this route. If a switch is private-labeled by one of the hottest names in the industry, the low-visibility manufacturer will receive credit where it is due.

OEM arrangements are all the rage for other reasons as well. Given the initial capital outlay required to research, develop and market a node, it is not advisable for most companies to brave the marketplace alone. Typically, a vendor toying with the systems sales idea has the technological know-how available in-house for some of the job. The rest is most profitably arranged through a joint venture or OEM deal. Almost all vendors currently manufacturing and/or marketing packet-switching equipment expect a significant increase in OEM arrangements over the next five years.

As vendors attempt to accommodate users with all levels of communications requirements, nodes are manufactured on a sliding scale: up in capacity for the vendor with a low-end offering and vice versa. Dynapac Co., which has always targeted the low end of the market, has plans to develop a high-end switch. Northern Telecom, at the other end of the spectrum, intends to OEM a smaller switch. Increasingly, companies contemplating a private packet-switching network have some low-end requirements in areas of the country with a low concentration of traffic.

Under these circumstances, a node purchase is cost-efficient only when its minimum capacity is small. In the future, large nodes will manage traffic in central locations on the network and smaller nodes will manage less trafficked portions on the ends of the network.

Finally, vendors have placed more emphasis on network management capabilities. For the user, the first level of concern is not the statistics collection; rather, it is fully functional diagnostics. In some proposals, the network management represents as much as half the cost of the network.

Capability will lose to cost-efficiency when stakes are that high. The year 1984 showed a maturation of network management in terms of functionality. New systems address the ever-changing status of the network by employing user-generated alarms, multilevel network security and on-line diagnostics with improved user-friendliness.

In 1984, worldwide stand-alone packet assembler/disassembler sales by U.S.-based vendors reached $34.5 million. A 30% growth year should occur in 1985, followed by a slight decline over a four-year period. Total worldwide shipments for 1989 are projected at $89.1 million. Vendor survey research conducted in March 1985 indicates Micom Systems, Inc., Dynapac and Memotec Service Corp. hold the lion's share of the packet assembler/disassembler market.

Marketing effort over the next year will be heavily concentrated on sales to the Bell operating companies. Local-area data transport (LADT) networks are about to undergo some major overhauls, and packet assemblers/disassemblers will play the largest part in the face-lift. The long-awaited improvement in local data transport and dial-up access to value-added networks will undoubtedly shore up a bountiful grab bag of new users. Everyone is clamoring for a piece of the action.

The U.S. is becoming the largest target market for packet assembler/disassembler vendors. Companies that have successfully penetrated the Canadian market — Memotec for example — are in the process of

... also offer seven personal computer publications. *InfoWorld*, the ... computer weekly, is a ... magazine for all personal computer users.

The other six are monthly magazines that ... on specific microcomputer ... the ... magazine ...

... And *RUN* ... 20 magazine.

... we have similar publications in every ... in the world. Our ... 35 countries. Argentina, Australia, Brazil, Canada, Chile, Denmark, Finland, ... Greece, India, Italy, Japan, Korea, ... The Netherlands, Norway, People's Republic of China, ... South Africa, ...

The sooner we hear ... sooner you'll hear ... reach your target ... to reach you. Call ... tion. You'll find ...

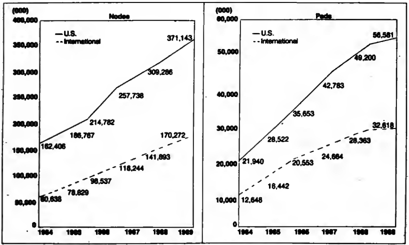


Figure 1. Packet-Switching Equipment Shipment Revenues

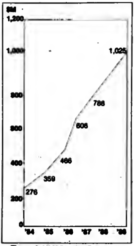


Figure 2. VAN Service Revenues

training their sales forces to attack the U.S. front. Domestically, the demand for packet switching is approaching its ripest moments. We will witness a greater division of the spoils in the near future. As the market approaches saturation (still many years off), the number of packet assembler/disassembler vendors will slack off again. Some will fail; many, as is the case with systems vendors, will develop OEM arrangements.

The X.25 gateways on wide-area networks are being introduced with increasing frequency, as are X.25/Systems Network Architecture (SNA) interfaces. The new generation of private branch exchanges (PBX) has X.25 support. AT&T's new PBX supports Levels Two and Three for X.25, for both permanent virtual circuit and virtual call modes. Northern Telecom's Meridian PBX will implement an X.25 interface, to be operable in the near future. All this suggests that access to X.25 will attain near-ubiquity within the next 10 years. As more and more data communications equipment supports this function, the packet assembler/disassembler manufacturers will inevitably fall upon leaner days.

An emerging trend that is not yet a threat to packet assembler/disassembler distribution is X.25 on a board. The protocol conversion function is now available on

an add-on board the user can buy with the terminal. Both Western Digital Corp. and Rockwell International Corp. manufacture X.25-on-a-chip for use with add-on boards. This offering won't penetrate the market for a while because hardware costs are too expensive to allow competitive product pricing.

Dial-up X.25, which was brought to market in 1984, will alter product functionality in the near future. On the terminal end of the network, X.25 has not caught on because synchronous interfaces are difficult to develop. X.PC and other proprietary protocols have fulfilled an intermediate need. As synchronous interfaces become better defined, X.25 will be available from terminal to network. With this new phase in communications, the procotol conversion function will become a commodity of sorts and will be available with greater frequency on modems and multiplexers. Vendors of 2,400 full-duplex modems will develop X.25 conversion capability as soon as it is feasible, and the resulting products will become significant contenders in the packet assembler/disassembler marketplace. Modem vendors will have an edge with their installed base. Although retrofitting modems for X.25 conversion does not seem a viable solution at this time, the installed base of users will go for a known evil and purchase the capability from their modem companies.

In anticipation of this emerging market, some versions of integrated packet assemblers/disassemblers and modem functions are already available. In February 1985, Wolfdata, Inc. announced its WD212-X.25 Integral Modem/PAD and its WD212-X.25 Stand-Alone Modem/PAD. The integral unit is compatible with the IBM Personal Computer, Personal Computer XT and Personal Computer AT systems and the AT&T 6300 PC. The stand-alone unit interfaces through RS-232. Both connect with Telenet's

recently announced dial-in service and are upgradable to X.32.

The packet assembler/disassembler function will expand as the board gets smaller. A considerable portion of the traffic out there runs on asynchronous, but IBM's 9-bit bisynchronous Synchronous Data Link Control (SDLC) will continue to grow in popularity. Over the next few years, vendors are looking to further accommodate the IBM environment. SDLC packet assemblers/disassemblers are becoming more prevalent. Asynchronous-to-X.25 and SDLC-to-X.25 will more frequently be available on the same packet assemblers/disassemblers. Multivendor compatibility is the overriding theme; better to accommodate too many than too few. Market revenues for 1984 reflect, at most, 20% bisynchronous-to-X.25, SNA/SDLC-to-X.25 packet assemblers/disassemblers. Current offerings are still comparatively expensive. The price will be driven down as more such products are brought to market (several companies are developing or looking to OEM a bisynchronous/SDLC packet assembler/disassembler).

In anticipation of lower margins a few years from now, packet assembler/disassembler manufacturers developed cheaper hardware in 1984. New products, as was the case with nodes, reflected a commitment to accommodation of all user types, from large to small. But they also boasted higher speeds and more flexible conversion capability in smaller boxes at lower list prices. The development of dial-in X.25 will significantly contribute to future customer premise equipment sales, which currently comprise only a small portion of 1984 packet assembler/disassembler shipments. Further, the Bell operating companies' asynchronous-to-X.25 conversion waiver targets them as packet assembler/disassembler users on a grand scale. Most players are repositioning to grab a piece of this emerging business.

Overall, we can safely project a bullish packet assembler/disassembler market over the five-year forecast period.

Powers is a senior analyst, Communications Industry Research, International Data Corp., Framingham, Mass.

Forecast Notes

☐ Dollar value of nodes and packet assemblers/disassemblers is forecasted at a decreasing growth rate over a period of five years. Price competition is expected to become stiffer in the equipment marketplace. Packet assemblers/disassemblers in particular will decrease in price for the following reasons:

• The bisynchronous packet assembler/disassembler, which is included in this forecast, is still very expensive. As more vendors introduce these products, the price will fall.

• The packet assembler/disassembler function will be available on other types of data communications equipment such as modems and add-on boards, which will force the packet assembler/disassembler price down.

• Down-sized packet assemblers/disassemblers with a lower minimum port capacity are already infiltrating the market.

☐ Market size is based on total shipments of U.S.-based vendors. Shipments represent units/systems that are newly built and sent to end users or OEM suppliers in any given year. Refurbished equipment that is reinstalled is not included in shipment estimations. In some cases, shipments are greater than the net addition to the installed base, a discrepancy that is attributed to the retirement of currently installed products.

☐ The dollar value of shipments is based on the total revenue intake from surveyed vendors over calendar year 1984. Numbers for the revenue forecast are derived by increasing this shipment base by a given percentage each year. The forecast for nodes runs at a compound annual growth rate of 19%. The stand-alone packet assembler/disassembler market will grow at 30% until 1986 and will then experience a more rapid decline due to the introduction of alternative product offerings.

☐ Dollar value of packet-switching services and equipment is represented in nominal dollars throughout the forecast.

☐ The dollar forecast for nodes reflects a depression in overall revenues during the 1984 and 1985 time period, at which point growth picks up to 20% yearly until 1989. This illustrates the fact that node prices are rapidly declining. International Data Corp. attributes this drop to the entrance of new players that can offer switches at a greatly reduced price as a result of new micro-based technology.

Some vendors still manufacture dinosaurs, which must be sold at a premium to compensate for production costs. As a result, node prices have been maintained at an artificially high level. Over the next two years, these vendors will adopt existing new technology, and node prices will drop consistently across product lines.

Following these reductions, the market will experience a small resurgence in price escalation as newcomers become established. Price/performance ratios will assume the texture of the minicomputer-based markets (for example, they will be based on improvements in technology).

HERSHEY'S GETS CONNECTED

Hershey Chocolate's goal of a computer on every desk by 1990 is requiring clever space planning. Hershey has met the challenge through some innovative cabling strategies aimed at reaching that goal.

By Lee White

What do you do when your long-range directive is to put a computer on every desk, but a jungle of cables is already threatening to overtake normal operations?

Dennis McNamara is a mechanical engineer in the Technical Services Department of Hershey Chocolate Division, Hershey Foods Corp. in Hershey, Pa. McNamara's technical expertise is unquestioned, given the 14 years he has spent at Hershey, but a sideline to his chosen field is an aesthetic sensibility that was offended on a daily basis by the cable jungle.

McNamara had been reading about flat undercarpet wiring for data communications and hoped someday to try the concept in a small pilot project. About this same time, members of the executive suite at Hershey were looking at how best to couple the company's short-term and long-term growth with sophisticated future office automation plans.

Instead of a small pilot project, McNamara was given what he saw as the plum assignment of his career: 52,000 square feet of project, half of which is new construction and half of which is renovation. When finished, the space would house Hershey's entire computer center, 10 other departments and more than 270 employees.

The project began in October 1983 with an in-house study. Because so many people with varying needs were involved, input was solicited from everyone. "We surveyed people throughout and asked them what they wanted, what their needs were and what it would take to do their jobs better," McNamara said.

From the beginning, it was obvious that trying to update the wiring system using conventional methods would nullify many of the benefits anticipated from the change to a modular, open-office environment with movable partitions. The old wiring, which included floor ducts, power poles and a network of surface wiring, could no longer accommodate employee needs. Because management's goal was

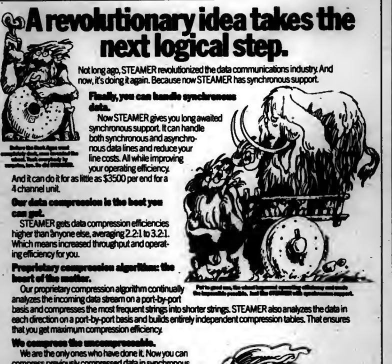
to place a computer terminal on every desk by 1990, the company decided to connect all electrical, communications and data processing equipment with flat, undercarpet wire.

All the engineering for the project was done with Hershey employees; McNamara was the project manager and mechanical engineer. His skills were supplemented by an in-house electrical engineering group, staff from Information Services Department and Network Control Center representatives who provided needed information regarding the telecommunications function.

As a hedge against future needs, the team elected to install three-pair telephone lines, although only one is being used at this time. The cost to install the cable with an extra two pairs was minimal compared with the cost of installing more cable some years down the road.

As a hedge against future needs, the project team elected to install three-pair telephone lines, although only one of the pairs is being used at this time. As with most facets of new construction or renovation, the cost to install the cable with an extra two pairs was minimal compared with the cost of installing more cable some years down the road. Installing spare pairs is becoming quite common, according to Chris Rottman, market manager for undercarpet wiring for AMP Products Corp., the supplier of undercarpet wiring for Hershey. "We see a lot of people putting in even four pairs, and they only use one for the electronics, which gives them two or three additional if they eventually want to go into their own PBX and carry data and voice."

The initial cost of flat wire — $1.25 to $1.50 per foot, compared with conventional round wire or twisted-pair at about 20 cents per foot — did not deter McNamara and his group, nor did it faze upper management. In order to use traditional round cable, the company would have to lay ducts beneath the floor, at a price of about $3 per foot. By directly installing flat power, telephone and data cable on the existing floor, Hershey would avoid costly disruptions to its building, half of which was occupied throughout the renovation. Faster installation time for undercarpet wiring made tight deadlines practical. The final argument for flat wire was that the company retained the option to implement new designs at any time, a strong possibility given the historical and anticipated growth rate and practicality of an open-office environment.



Work first began on the 24,000 square foot north side, formerly a warehouse for finished goods and constructed with concrete floors covered by tongue-and-groove maple flooring. This area was completely rebuilt: new rooms; new heating, ventilation and air conditioning (HVAC) system; and dropped ceiling. The walls and ceilings were insulated with 2½-inch fiberglass sound-absorbent batting, one of several measures taken during the renovation to reduce noise pollution from electronic equipment.

The engineering group decided to locate the uninterruptable power supply room on the north side and to increase its capacity from 100 to 300 kilowatts. This upgraded facility will provide 15 minutes of backup battery power to the computers in case of electrical failure. Also located on the north side were the main computer room and the network control center linking all Hershey's computers.

The undercarpet wiring was laid directly on the wooden flooring. The wiring was 3- and 5-conductor, size 12 American wire gauge flat power cable rated at 20 amps. The 5-conductor cable provides an isolated ground to protect sensitive computer equipment. Because the cable was supplied in preshielded form, it already had the top and bottom protective polyvinyl chloride layers attached to the basic cable assembly. It could be unrolled on the floor in a single pass, following chalk lines that had been snapped on the basis of Hershey's blueprints and AMP's computer-assisted design. The copper cables are encased in laminated polyester. The .043-inch thick power cable, which is flexible and can be folded over on itself to change direction, was run from flush wall transition boxes, where it connected to the round wire conduits, to AMP's low-profile, safety seal floor fittings.

To service its electronic equipment, Hershey specified AMP's 75- and 93-ohm undercarpet data coaxial cable. Single red cables for IBM Model 3178, 3180 and 3279 CRT devices and printers and twin gray cables for Wang Laboratories, Inc. word processing workstations were run from separate wall boxes. Changes in direction could not exceed a 5-inch radius and were made by notching the cable's

supporting web. Intersections with power cables were kept to a minimum and were made only at right angles.

To complete the undercarpet wiring, Hershey used 3-pair flat telephone cable on reels and 25-pair flat cable in predetermined lengths with connections, a total of about 1,300 pairs. All rooms were completely wired before being carpeted with 18-inch Milliken and Co. tiles. Unterminated branch lines were run in anticipation of future desk and equipment placements and, with an eye to future flat wiring, even conventionally wired private offices were carpeted with modular tiles.

When the north side was ready for occupancy, employees from the south side were shifted to their new quarters. Undercarpet wiring installation on the south side was similar to that of the north, except that, after it had been cleaned, patched and leveled, the concrete floor was coated with a commercial sealer to hold down dust and improve adhesion.

Rather than abandon its floor ducts, Hershey utilized them for the telephone wiring in conjunction with the flush floor service boxes. Openings were cut in the concrete for the approximately 14-inch square by 2-inch deep service boxes, and conventional telephone wiring was pulled to them through ducts, with the aid of nearby access ports. At this point, the transition was made to flat telephone cables that extended throughout the room.

Because undercarpet wiring did not require any noisy or dirty construction, work proceeded during daytime hours without disrupting office activities. McNamara said extensive research at the beginning of the project led to the estimate of four man-hours per receptacle for installation. By the time the project was completed, the time was down to one man-hour per receptacle. "We can't put in hard wiring in an hour's time. We can't even put a receptacle in a wall in an hour. In the third phase of construction, we did around 7,000 square feet and did all the electrical work in a week's time. That's everything — data, telephone and power," McNamara enthused.

Although Hershey representatives would not divulge the actual cost of the project, McNamara said the tracking systems in place indicate costs are "right at the level of approval." And expensing the project was very difficult. "When you consider that we put dollar values together for things like the uninterruptable power supply room, the network control center, conference rooms and flat wiring, you couldn't talk to anybody who could really give you a lot of insight into [project cost]. There were so many new concepts," McNamara explained.

One of the new concepts was the Quadralong lighting system, designed by Armstrong World Industries, which allows for running computer analysis of lighting levels. Hershey settled on Steelcase, Inc. as the sole vendor for furniture and movable partitions. The choice of Steelcase was a good one, McNamara explained, primarily because of Steelcase's accommodation to Hershey's methods of construction. At one point, Steelcase had 17 tractor-trailer loads of furniture delivered to the site, McNamara said. "Right in order, everything in [each trailer] just the way it's supposed to go in. Talk about coordination. It was phenomenal the way they brought it in."

Perhaps the most amazing piece of the whole project was the short amount of time that elapsed from beginning to end. McNamara got funding approval in the spring of 1984, work began in July and the entire project was completed by June 1985.

Perhaps the most amazing piece of the whole project was the short amount of time that elapsed from beginning to end. McNamara got funding approval in the spring of 1984, work began in July and the entire project was completed by June 1985. McNamara attributed the speed of the process to the project team — one person from purchasing, the building office manager, an industrial engineer, information systems representatives, two full-time construction coordinators and telecommunications specialists.

In addition to in-house personnel, vendors played an important role. After construction began, meetings were held every two weeks with the foreman of the outside construction firm and the electrical foreman. Also on the project team were in-house regulatory affairs people; safety officers; and electrical, mechanical and HVAC-type support staff. All these people went over power requirements, reestablished distribution panels, arranged for new lighting and power panels and brought the 1,300-pair phone system up to the IBM 3083 mainframe computer.

During the period of construction, staff who previously occupied the floor were moved to other areas for short periods of time. The one area that stayed put was the computer room, according to Bruce Dieffenbach, director of the Information Services Department. Other systems personnel were moved, but arrangements were made for temporary dial-up capabilities.

The computer people experienced no downtime and were never out of the system during the day. Cutovers were arranged to occur on a Sunday, when scheduled computer operations were finished.

The course of construction did not always run smoothly. Problems abounded, according to McNamara, but the team took great pains to see employees were not affected. In the first phase — the north side ex-warehouse area — McNamara requested that AMP supply the wiring in predetermined lengths with standard connectors. When installation began, he found last-minute routing adjustments resulted in excess cable that had to be trimmed and reterminated. Because this wasted great amounts of wire, McNamara decided to purchase reels of cable for the south side and terminate it to the exact lengths required.

The biggest problem McNamara and his team faced was the possibility that something very big could go wrong. They worried about equipment deliveries, scheduling, "just the day-to-day routines of having everybody provide services and equipment they had to provide to keep everyone going," McNamara said. A persistent fear was that an accident could shut down the entire computer system. "We had to make tie-ins to the uninterruptable power supply room which are also tied into the halon system," McNamara explained. If a mistake were made during the construction operation, the halon system could be tripped, which, as part of the normal shutdown procedure, would in turn trip and throw the equipment down.

Dieffenbach shared McNamara's fears. "We were ready for all kinds of problems. We thought surely something was going to jump up and bite us, but it never did." Dieffenbach attributed the success to McNamara and the project team. The computer people experienced no downtime and were never out of the system during the day. Cutovers were arranged to occur on a Sunday, when scheduled computer operations were finished. "[The project team] would make a cutover from the old power system to the new power system and cut over to new transformers and new telephones — all that was done so it didn't interrupt our operations. It was probably a burden to schedule, but it was no problem for us. We had no disruptions. But [McNamara] used to have jet black hair before this job started, and he was 6 feet tall, too, before we beat on him," Dieffenbach laughed.

Dieffenbach was also pleased with the final results of the flat wire system, but tempered his enthusiasm with the caveat that flat wire could not work in all installations. At Hershey, the development staff, the computer room and the room where all experimental equipment for system development and printer and terminal trials are made are connected with flat wire, but the average run is 30 to 40 feet. AMP's Rottman explained that short runs are safe runs for flat wire and added that with flat wire, "the attenuation rate is about three times as great as with normal round wire." There are systems staff members who are in buildings other than that which houses the mainframes, Dieffenbach said, but their terminals are connected to the mainframe via short-distance modems, local dial-up, dedicated phone lines and control units in their locations.

Whether the flat wire concept will be carried out in other parts of the Hershey facility remains to be seen, but the renovation project has attained high visibility in the company. According to McNamara, the anticipation level as the project neared completion was very high. "There was a buzz going on. People were really excited about moving into something they were going to appreciate. I think it has been very well accepted by the employees," McNamara said. But he added that it couldn't have been done without the top-down support from management. "Nothing was done 50% or 75%. What you see is representative of what people's needs were, and they got it."

White is a senior writer at Computerworld Focus.

will be a key issue in all facets of communications.

What form will this portable and mobile communications system take? Cellular telephones in automobiles constitute an intriguing and interesting beginning, but car telephones simply are not the wave of the future many would like you to believe. The form that telecommunications device will take presents interesting possibilities. Systems that were gizmos yesterday are becoming feasible and practical. Telephones in briefcases, for example, are becoming lighter, smaller and less expensive. And, if the evolution of the electronic calculator from 1970 to 1976 is any example, we can anticipate that these telephone sets will become increasingly more portable, which will lead to our taking them anywhere we go, not just in our cars.

These roaming telephones in turn begin to pave the way for Dick Tracy-type wristwatch radios, which — believe it or not — will be with us in a short time. The actual devices will be utilized for cellular services and are only as limited as our design and marketing imagination.

Applications for cellular services appear to be endless. Cellular services for bypass? Why not? In essence, that's already happening with the nine-wire line carriers. Cellular service in lieu of terrestrial services for remote costly service areas? Of course. This becomes a strength of the operating company.

But operating company or not, industry experts agree the future for cellular service takes us into areas far passing our present realm of imagination. George Blasingame, general manager of Cellular One in Memphis, gave the following description of the future scenario: "Any person, business or resident will have a personal communicator. When you walk out of your home, your personal communicator will be in your pocket. In your automobile, you will plug it into a cassette-type device that will operate on a hands-free, voice-actuated process. Data communications will be built into a screen in the car. The personal communicator is charged as it is used.

"The personal communicator is popped into your desk module upon arrival at work. During this process, it works behind the PBX attached to the cellular network.

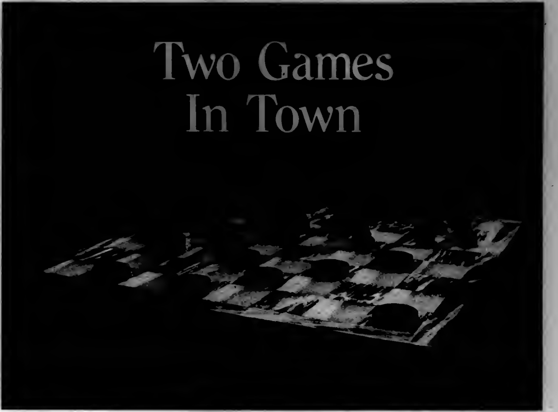
"After work, the personal communicator accompanies you for nine holes of golf or a couple of hours on the tennis court. At the end of the day, the personal communicator is popped into a charger by your bed, and during that time it is charged as well as utilized for your bedside telephone," Blasingame said.

Comparing technology of cellular services today with technology a couple of years from now is similar to comparing an IBM 360 with today's personal computer. Technology enhancements that will lead to this future world of communications are surprising, for they will not be memory storage enhancements, improvements in chips and integrated circuits or improvements in networking itself. The key will be battery technology, and estimates state that AT&T is now spending well into the tens of millions of dollars on improving current battery technology.

The good news of all the activity in the area of cellular services will be better service in remote locations; less expensive service for rural areas; executive and senior management mobility; opportunities for handicapped and severely disabled people to work from home; more flexibility in business locations; and new products, concepts, technologies and jobs.

The bad news? More interruptions. More people will be able to find you. More ways for people to know where you are — remember, the computer has to know where you are to place the call. More invasions of privacy. More regulations. More decisions. But most important of all, the opportunity to get a wrist telephone with a little antenna like Dick Tracy's.

Horrell is president of Mitchell and Horrell, Inc., a telecommunications consulting firm in Memphis, Tenn.



The rivalry between local-area networks and private branch exchanges has heated up as the need for efficient and cost-effective communications grows more urgent. Here are some pointers that will help your organization win this round.

By Stuart Wecker

Local-area networks and digital private branch exchanges (PBX) are the focal points of current communication network developments. Local-area nets provide efficient mechanisms for interconnecting computers, terminals, word processors, facsimile and other systems within a local environment. PBX add data communication capabilities to the voice system for interconnecting computer equipment and digital devices. We will focus on the digital PBX and the integration of voice and data communications within a common switching system framework.

Information applications can be seen to consist of four components: the user component, providing the stimulus to the application and the recipient of the response; the application program, the information processing unit; the file system, the storage unit component for temporary and permanent information storage; and the communication network, connecting the other three components and providing the necessary communication paths for information exchanges. This model applies to both data and voice communications.

The communication network can be totally local or it can be nationwide or worldwide. If the capacity of the network is sufficient to carry the required traffic among the other three components and provide the proper response characteristics, the user will be totally unaware of whether the application and the file system are local or thousands of miles away.

Integration of voice and data communications means the unification or sharing of components or information. Integration is, therefore, an individual perspective as viewed from each of the four components. There are four possible alternative definitions of voice/data integration. At the user component, integration is the coupling of the voice and data user components (for example, a terminal device with voice and data capabilities). This integrated device can provide services such as Rolodex dialing, where a user data base of names and phone numbers is brought to the screen. When the cursor is placed over the correct location, a call button is pushed and the phone number is dialed. Typical examples of devices with such capabilities are the Displayphone from Northern Telecom, Inc. and the Cypress terminal from IBM/Rolm Corp. It is possible to build such an integrated terminal with voice and data capabilities, yet have this device connected to two separate networks — a data network and a voice network. It still appears to the user as providing an integrated voice and data service. The integration is brought together at the user level.

Integration at the application component could be via an electronic mail application with voice and data mail segments. An editor for this system would have the capability of editing both the data component of the document and the voice component of the document. Such a system would provide information in its most appropriate format to the mail user. Similarly, the third perspective for integration is at the file system component, where a common storage file subsystem could be used for both voice and data components.

The last component for integration is at the communication network itself. Information can be sent from voice telephone instruments to other voice instruments and from terminals to host computers and filing systems over a common network structure. This integrated network is currently the domain of the data/voice PBX, integrating voice and data transport services within a common network. The public version of this integration will be the integrated services digital network (ISDN) providing worldwide integrated data and voice services. A combination of these public and private networks will then lead to a total integrated network where the local integrated voice/data PBX, local-

area networks, terminals, applications, host computers and file storage subsystems can all be interconnected on a global basis (see Figure 1).

What are the advantages of integrated voice and data communications over separate network systems and services? Integration at the user, application and file system components provides a flexible set of user information services. That is, information can be presented in its most appropriate format.

Integration at the communication network is desirable for reasons other than for user services. An integrated network is economical due to the sharing of channels and switching system capabilities. This sharing results in reduced installation and maintenance costs for the network compared with two separate networks. By integrating two networks into one, the management and maintenance of the combined network should only cost about as much or only slightly more than that of one of the individual networks. Integration of the networks also increases its data connectivity — the ability to access digital data components at any location where there is a telephone instrument. PBX offer integrated voice and data communications with high function network management features. These include the ability to account for the usage of the PBX for information transfer and the ability to divide users into various service classes restricting their service to specific connectivity and features within the system.

Another benefit of an integrated voice/data PBX is the eventual interconnection to the worldwide ISDN mentioned above. Over the next few years, the major PBX vendors will be building interfaces to this network.

The purpose of a communication network is to provide an information path among communicating resources. These resources may be computer terminals, host computers, file servers and other digital communication devices. The service requirements of each resource pair conversation vary with the requirements of the specific application. What is important is that the network must satisfy the service requirements of its applications and its users. Possible network service requirements are:

- Performance (throughput, delay).
- Data (integrity, block size).
- Flow (sequencing, control, guarantees, uniformity).
- Connectivity (addressing, establishment).
- Reliability and Availability (failure modes).
- Maintainability (failure isolation, removal, testing).
- User Interface (circuit, transaction, burstiness, rate).
- Information Mode (analog, digital).

An examination of a range of information applications shows that the service requirements of each application differ. The purpose of a network is to meet as broad a range of service requirements as possible to serve the needs of a wide range of users.

PBX have evolved from an analog-based technology to a digital-based technology. This has been due in large part to the reduced cost of integrated digital circuits, making it more economical to build a digital PBX than an analog one. The development of the digital PBX has also been driven by the need for stored program control to manage the ever-increasing array of PBX user features. The evolution has additionally been motivated by the move to digital transmission technology, resulting in the ability to transport more information over the same pair of wires.

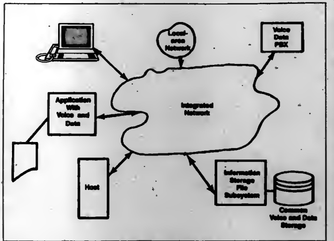


Figure 1. Total Integration

The newer digital PBX are designed to provide integrated voice/data services, thus expanding their domain from voice-only services to digital data services as well. Prior to integrated digital PBX, data could always be sent over a voice-only network by making the data appear as a voice communication (see Figure 2). Modems convert the digital bit stream into an analog representation compatible with the frequency characteristics of the human voice, thus enabling the data to be transmitted through the analog network. The major drawbacks are the limitation on the maximum speed of transmission and the relatively high cost of the modems.

The alternative is to transform voice into a digital representation. In a digital PBX, the analog voice signal is converted into a digital form by representing the amplitude of the analog signal at periodic sampling points by the corresponding digital value. In computer terminology, this is an A to D conversion. The telephone industry uses the term pulse code modulation (PCM) for this signaling conversion. If the signal is sampled frequently enough and a fine enough representation for the amplitude of the signal is used, the digital values can be transmitted over the network and at the receiving side of the network converted back into their corresponding analog voltages. Using smoothing circuits, the original analog signal will then be re-created.

The standard digital representation used in the U.S. telephone PCM system is an 8-bit value, the high-order bit being a sign bit and the low-order 7 bits being the value of the signal on a logarithmic-type scale. The signal must be sampled frequently enough to retain all of its information.

Information theory tells us this sampling rate must be at least twice the highest frequency of the signal. It is assumed that voice in the analog system is bandwidth limited to be between 300 and 3,400 Hz. Sampling this signal at 8,000 sample/sec is, therefore, a safe value. This rate times 8 bit/sample results in the standard bit rate of 64K bit/sec for each voice pathway. A two-way conversation requires two 64K-bit/sec paths, one in each direction. Digital PBX create digital conversation paths that have the capacity for transporting 64K-bit/sec streams, specifically divided as 8,000 samples of 8 bits each. Because digital data is also typically in the format of 8-bit units (bytes), it is a relatively straightforward task to use a digital PBX that can transport digitized voice and have it transport digital data as well.

Contrasting the service requirements of digitized voice and typical digital data transmission, the timing requirements of a digitized voice transmission are significantly more stringent than those of an interactive or transaction-based data transmission. The voice requires a 64K-bit/sec constant bandwidth and delay path, an 8-bit sample arriving every 125 microseconds. Interactive terminal and transaction base traffic are significantly less stringent in both their bandwidth and delay requirements. For this reason, a PBX designed to meet the timing characteristics of voice can easily meet the requirements of most digital data transmissions.

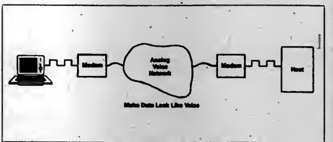


Figure 2. Analog Transmission of Data

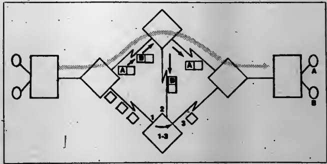


Figure 3. Switching

Switching is the heart of a communication network. It is the component that transfers information arriving at an entry point or port in the network to an exit port. Each switching unit in the network performs this transfer from incoming to outgoing ports. If the communication network consists of more than one switching unit — switching nodes connected together with intermediate channels — a routing algorithm is required above the switching technology to build paths through the switches, creating paths between the endpoints of the network. Routing is, thus, a cooperative execution by all of the distributed switches to create common paths.

Switching requires identification of the incoming information to determine to which port or channel it should be sent out. In circuit-switching technology, channels are dedicated to conversation paths and the incoming physical channel or port address is used to identify the information. In packet-switching technology, channels are shared among conversation paths and information is switched based on an address that is part of each information block — a data item address. Circuit switching is used by digital PBX. Packet switching is used by both local-area networks and wide-area data networks (see Figure 3). In circuit switching (in the lower part of the figure), data blocks arriving on Channel 1 are switched out to Channel 3 through the switching unit, independent of information contained in the incoming data blocks. The upper part of the figure shows packet switching, where individual data blocks are preceded by an address. The switching entity uses the address to decide on which outgoing channel to send the information.

Circuit switching implies dedication of channels to specific information streams; packet switching allows channels to be shared dynamically, block by block, among a number of information streams. These two technologies have evolved based on the specific flow characteristics of voice and data. Digitized voice transmission is a smooth, steady flow of information, well-suited to circuit switching. Interactive data traffic is a flow of bursty blocks of information, well-suited to the channel sharing of packet switching. In typical circuit switching, a dedicated path is formed from dedicated channels and switching elements, the path being reserved for the duration of the connection. The path is of fixed bandwidth and delay, and unused bandwidth cannot be shared with other users. It is efficient for constant flow traffic as in digitized voice transmission. Packet switching creates a path formed from shared channels and switching elements. There are ususally no fixed paths through the network; each packet is independently routed according to a routing algorithm. Channels are, therefore, shared and bandwidth dynamically allocated on demand. The routing algorithm can create static or fixed routes or be adaptive — changing routes when changes occur in the network topology. Bursty traffic over package switching networks results in a network with high component utilization and efficiency. For smooth flow traffic, circuit switching is highly efficient.

In the typical local-area network approach to data using packet-switching technology, information from one network interface unit (NIU) is sent to another NIU by creating an information block with the appropriate destination and source addresses preceding the data and sending it out on the media. This information is received by all NIU and processed by the one to whom the destination address corresponds. Different users at different points in time can transmit blocks on the media, interleaving conversations among a variety of users. The media in the local-area net is performing the packet-switching function. When many user conversations are active, virtual circuits — a higher level concept — keeps one conversation path separate from another by creating a second level of addressing within the data field. This address multiplexes the conversation of each user into the single stream between NIU. The PBX approach to voice uses circuit-switching technology. When one telephone wishes to create a conversation path to another telephone, the PBX assigns a fixed portion of its bandwidth to that conversation, two 64K-bit/sec pathways. These paths are dedicated to the digitized voice conversation between the users for that conversation.

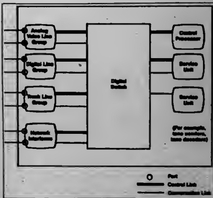


Figure 4. Voice/Data PBX

It is important economically to strike a balance between service requirements and cost of the switching system. Usually you would optimize the switching system technology around the service requirements of the highest usage application with the constraint that the service requirements of all the users of the switching system must be met. Generally, voice has more stringent service requirements than data. Most current digital PBX can easily support the service requirements of both voice and data. The worst consequence of sending bursty data over a circuit switch network is that some of the bandwidth of the dedicated conversation path will be wasted. On the other hand, voice cannot usually be sent over packet networks. The packet network would have to be designed to meet the stringent delay characteristics of the voice and be structured to economically transmit the small blocks of digitised voice information. Generally, it is not economical or efficient to use packet technology for the smooth voice transmission. As a result, there is a movement toward the use of digital PBX to carry data.

There is no reverse movement with local-area networks adding voice.

Integrating voice and data communications through a common digital PBX is motivated by the sharing of the communication system, within both the wiring structure and the switching electronics. This sharing results in lower installation and maintenance costs for the integrated network. In addition, the capacity of the switch can be shared between the data and the voice usage. Digital PBX, based on circuit switch technology, provide privacy of data on each user conversation path compared with the open nature of the shared concept in local-area nets. Digital PBX also offer high-function centralized network management, and some offer very high bandwidth digital data transmission over inexpensive twisted-pair wiring.

Figure 4 on Page 63 shows the typical architecture of a voice/data PBX. The digital switch component creates 64K-bit/sec circuit switch pathways between the users or ports attached to the switch. Attached to these ports are a set of interface units that transform incoming and outgoing information into the standard 64K-bit/sec internal format and local-service units that serve as internal end points of circuits. The interface units include standard analog voice line groups interfacing standard analog telephone sets, digital line groups interfacing digital telephone sets and trunk line groups interfacing to the public telephone network. The analog voice line interfaces provide the digitized sampling and the creation of the 64K-bit/sec stream from the incoming analog voice. The digital interfaces manage the incoming voice, data and control information from the new digital telephone sets. Trunk group interfaces provide an interface to the public telephone carrier central office using standard ground start or loop start trunks. The most recent developments in interfaces have been in network interfaces that provide the transformation between external network standards and the internal digital switch. The most common interfaces are to X.25 and IBM Systems Network Architecture (SNA) nets. The service units are internal information sources and sinks and provide services such as tone decoding, conference bridges and various signaling tones for use by the other interfaces.

The switch operates on the principle of creating 64K-bit/sec circuit switch paths in the format of 8,000 samples of 8 bit/sample. It does this by creating conversation paths between the interfaces and/or service units attached to the switch. When a conversation path has been established, each 8-bit sample arriving at the digital switch on an incoming port in the conversation path is switched to an outgoing port. This switching involves information movement in space and time domains. In space switching, the 8 bits of information are physically moved from the incoming port on the digital switch to the outgoing port. In time, switching the 8-bit samples may arrive at the incoming port at an instant out of time synchronization with those to be sent out on the outgoing port. Time delays are needed to compensate.

The time switching is managed via buffering, where the incoming stream is buffered in intermediate 8-bit buffers until the proper time arrives for them to be sent to the outgoing interface unit. The buffers create a time independence through switch. Space switching is typically handled via a high-speed time slotted backplane bus, where the 8 bits of information are physically sent from an incoming interface to the outgoing interface through time slot positions on the bus. In some cases, buffering and time synchronization is managed within the interfaces. In other cases, an intermediate memory is added to the bus. Each vendor has a unique approach to implementating voice and data integration.

In the Oct. 16 issue of Computerworld Focus, *Wecher will discuss wiring and planning, the coexistance of PBX and local nets and current offerings.*

Wecher is president, Technology Concepts, Inc. in Sudbury, Mass.

Products

PALO ALTO, Calif. — Three micro-to-mainframe accessory products have been announced by CXI, Inc. Keyboard Mate is a keyboard attachment that adds 3270 series and 3270 function keys to existing keyboards, allowing CXI's Pcox and Digital Communications Associates, Inc.'s Irma emulation board customers to invoke 3270 functions with single keystrokes, the company said.

CXI's Coax Mate multiplexes signals from two controller ports through a single coaxial cable. The product links two category A coaxial devices (such as IBM Personal Computers that use any of CXI's coaxial connection boards or IBM 3270 series terminals) for data transmission over a single coaxial cable.

Daisy Chain Kit, the third product, is a modem bridge designed to permit several IBM PCs to be attached to a single leased-line synchronous modem.

Keyboard Mate's suggested retail price is $185. The Daisy Chain Kit and Coax Mate, the latter sold as a pair, are priced at $135 and $250 respectively.

For further information, contact CXI, Inc., 3606 W. Bayshore Road, Palo Alto, Calif. 94303-4229.

PALO ALTO, Calif. — The Wollongong Group has introduced a new line of networking software called Wollongong Integrated Networking Solutions (Wins), which the company said conforms to the TCP/IP protocols, a U.S. Department of Defense standard for networking communications.

WIN/PC lets IBM and IBM-compatible PCs participate in local- or wide-area networks, the vendor said, and is compatible with Wollongong's WIN/VX for Digital Equipment Corp. VAX minis. WIN/3B, a version to be distributed by AT&T for its 3B microcomputer customers, was also announced. Wollongong said the products share file transfer and virtual terminal capabilities. The file transfer feature allows the sharing of data across a network with any other machine, and the virtual terminal facility allows a PC or other computer to log onto another machine in a net.

WIN/PC costs $895 and quantity discounts are available. WIN/VX is priced at $15,000. Further information is available from The Wollongong Group, 1129 San Antonio Road, Palo Alto, Calif. 94303-4374.

WAKEFIELD, Mass. — Applitek Corp. recently announced Lantest, software that reportedly enables current Applitek users and those considering an Applitek local-area network to evaluate response time and throughput as the network load is increased from zero to 100%. According to the vendor, the software will also show the effect of running the network under various access methods such as CMSA/CD, token passing or Applitek's Unilink.

In addition to the software, Lantest includes four Applitek network interface units and a baseband, broadband or fiber-optic cable. Lantest will run on an IBM Personal Computer or compatible computer with at least 128K bytes of memory and a serial RS-232 port. Available immediately, the package costs $2,000.

Applitek is at 107 Audubon Road, Wakefield, Mass. 01880.

MILPITAS, Calif. — Racal-Vadic, Inc. has introduced the Multiple Data Set (MDS) II system, which the vendor said allows users to manage modems in a corporate dial-up network from a local or remote site.

MDS II consists of the VA1690 chassis, VA990 control card, VA2190 power supply card, VA4491E triple modem (2,400/1,200/300 bit/sec) and VA9000 system controller.

The VA1690 chassis is a front-loading, rack-mountable assembly with 16 slots for modems or other data communications products, one slot for the VA990 controller and one spare slot. Each of the 16 slots can accommodate two modems. The VA4491E is a V.22 bis-, Bell 212A- and Bell 103-compatible modem that can be configured

for either the switched-telephone network or two-wire leased lines, according to the vendor. It provides full-duplex asynchronous and synchronous operation at 2,400 and 1,200 bit/sec and asynchronous operation from zero to 300 bit/sec. The VA9000 system controller is a personal computer-based option that reportedly allows supervision, monitoring, configuration and testing of a network from a single central site and can control up to 256 MDS II chassis and more than 8,000 modems.

The VA1690 chassis, equipped with a VA990 controller card and two VA2190 power supplies, is priced at $3,260. The VA4491E modem costs $1,095, and the VA9000 System Controller with interface board for an IBM Personal Computer or compatible computer and proprietary software is priced at $3,500.

For more information, write to Racal-Vadic, 1525 McCarthy Blvd., Milpitas, Calif. 95035.

MERRIMACK, N.H. — **Digital Equipment Corp.** recently announced All-In-1 Office and Information System software for the Microvax family of computers. In addition, the company also announced that through DEC's PC connection capabilities, IBM Personal Computers can tie in to VAX and Microvax environments.

The Microvax All-In-1 includes WPS-Plus word processing, electronic mail, desk management, time management and other office functions, as well as full Help functions and computer-based instruction. According to the vendor, the system can utilize Decnet and Ethernet communications for networking with other computer systems. Microvax All-In-1 also supports the Decmate Office Workstation, the Rainbow Office Workstation and the PRO Office workstation. The cost for the system is $4,023 per subscriber on a 30-subscriber system.

DEC's PC connection capabilities include a series of software products that enable IBM Personal Computers to communicate and transfer files with Microvax II and other VAX systems. With Decnet-DOS, IBM Personal Computer users can share data and files across a network, develop distributed applications and participate in other network functions. Vterm II allows the IBM Personal Computer to emulate a DEC VT-100 terminal and Poly-COM 220 and 240 enable IBM Personal Computer systems to perform file transfers and emulate DEC VT-200 terminals, the vendor said. Decnet-DOS sells for $495, Vterm II is priced at $160 and Poly-COM 220 and 240 cost $200 and $300, respectively.

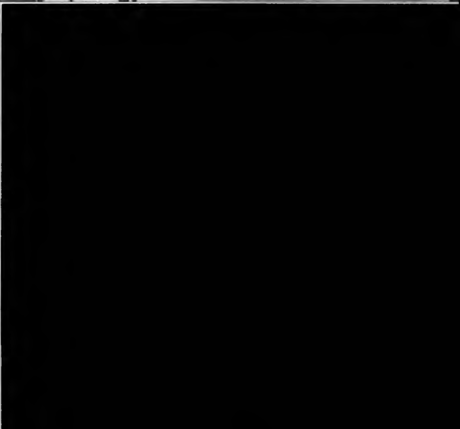
DEC also announced enhancements to its VAX VTX videotex software and Rainbow/North American Presentation-Level Protocal Syntax (Naplps), which extends videotex capabilities to the Rainbow personal computer.

For more information, write to Digital Equipment Corp., Maynard, Mass. 01754.

PALO ALTO, Calif. — **Hewlett-Packard Co.** has introduced Systems Network Architecture (SNA) analysis software for its field-portable HP 4951A and the HP 4953A protocol analyzers.

Using both the HP 18186A and the HP 18153A SNA analysis packages, Hewlett-Packard protocol analyzers extract the upper-level information field by field from Synchronous Data Link Control (SDLC) I-frames and display it in high-level, easy-to-read SNA terms, HP said.

The HP 18186A/4951 is a portable SNA testing tool and provides the information needed to locate problems, particularly between cluster controllers and the SNA network, the vendor said. The HP 18153A SNA analysis application for the HP 4953A protocol analyzer allows the user to monitor, capture and analyze data traffic anywhere on the SNA network, even complex host-to-host communications, the vendor said. Both packages support simulation by allowing the user to define menus designed to trigger and send specific SNA messages. In addition,



the packages can be employed anywhere SNA data flows over an SDLC link that uses any of the physical interfaces supported by Hewlett-Packard, such as RS-232C, V.35 and RS-449.

The prices for the software are $500 for the HP 18186A and $750 for the HP 18153A. HP is at 1820 Embarcadero Road, Palo Alto, Calif. 94303.

DALLAS — An enhanced version of the NCS70 Series Network Control System was recently announced by **Emcom Corp.** Among the enhancements is a real-time error and status message report, which allows the operator to scan the record of alarm conditions to identify recurring problems on a specific line or device. In addition, performance statistics can be transferred from the NCS70/30 to a host-resident data base, supported by Emcom's software, Network Communications Performance Analyser.

The basic NCS70/30 system includes one rack-mountable performance measurement unit, an IBM Personal Computer color terminal and a four-color printer. Prices for the NCS70/30 begin at $75,000 for a 16-line system. For more information, write to Emcom Corp., Suite 901, 101 E. Park Blvd., Plano, Texas 75074.

CHELMSFORD, Mass. — **Apollo Computer, Inc.** has introduced its Open Architecture Program with a set of network products designed to integrate Apollo's Domain networking architecture with IBM's SNA, Digital Equipment Corp.'s VAX/VMS operating system and IBM PCs, PC ATs and compatibles.

The Domain/SNA package is aimed at distributing SNA resources across Apollo; Domain/Vaccess-1 downloads files from DEC VAX/VMS applications to the same applications on the Domain system. Domain/Vaccess-1 uses the Ethernet 802.3 transport standard and TCP/IP for data conversion. Domain/PCI is designed to allow certain personal computers to connect with Apollo workstations and share files. Domain /SNA is licensed at $1,700 per node, $7,000 per site; Domain Vaccess-1 at $5,000 per site; and Domain/PCI at $500 per node.

Apollo also introduced Domain/Bridge, a hardware and software communications package, which the company said provides the means to link up to five Domain networks and make them function like a single net. Apollo spokesmen said users have two Domain/Bridge link options: Domain/Bridge-A, a T1 class carrier link intended to extend the Domain single-system image across long distances; and Domain/Bridge-B, a coaxial cable link intended to partition large networks and make them more manageable. Domain Bridge A costs $8,400, one-time purchase; Bridge B, $8,900.

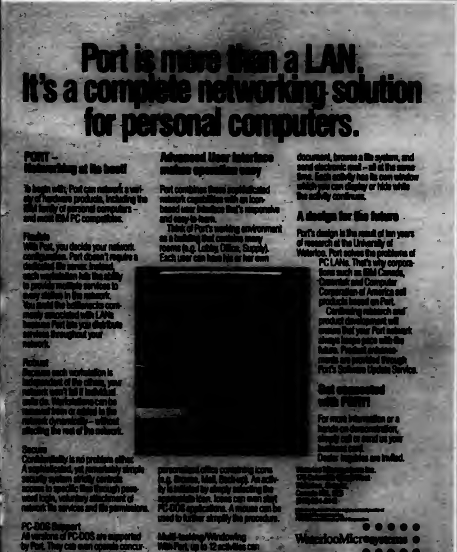
More information is available from Apollo Computer, Inc., 330 Billerica Road, Chelmsford, Mass. 01824.

SAN ANTONIO — **Datapoint Corp.** has introduced multimedia information network exchange (Minx) an office system that integrates data, voice and full-motion color video communications, the company said.

Minx consists of desktop workstations and one or more central controllers or servers. Each cluster server supports up to eight Minx workstations. The Minx workstation incorporates a color monitor, color camera, viewfinder and full-duplex speakerphone. The workstation is controlled by a mode selector and an attached keypad, which resembles a pushbutton telephone. The Minx workstation can be attached to its Arcnet local-area network through a Datapoint-supplied IBM PC interface card, the vendor said.

Minx workstations are priced at $11,100 each for quantities up to three and are discounted to $8,880 each for quantities of fifty and over. The cluster server is priced at $9,020, and the Minx to Vista-PC and IBM PC interface cards are $295 each.

For further information, contact Datapoint Corp., 9725 Datapoint Drive, San Antonio, Texas 78284.



Calendar

September 3-6, Bloomington, Minn. — **The Integrated Office — How Soon?** Contact: Office Automation Society International, Suite B, 15269 Mimosa Trail, Dumfries, Va. 22026.

September 4-6, New York — **Data Communications System Components.** Also, September 9-11, San Francisco. Contact: Systems Technology Forum, 9000 Fern Park Drive, Burke, Va. 22015.

September 5-7, San Francisco — **3rd PC Faire.** Contact: Computer Faire, Inc., 181 Wells Ave., Newton, Mass. 02159.

September 8-11, Cambridge, Mass. — **1985 SME World Congress on the Human Aspects of Automation.** Contact: Technical Activities Department, Society of Manufacturing Engineers, P.O. Box 930, 1 SME Drive, Dearborn, Mich. 48121.

September 9-11, Washington, D.C. — **X.25 and Packet Switching Networks.** Contact: Systems Technology Forum, 9000 Fern Park Drive, Burke, Va. 22015.

September 9-11, New York — **Local-Area Network.** Contact: Systems Technology Forum, 9000 Fern Park Drive, Burke, Va. 22015.

September 10, New York — **Microforum Luncheon and Conference.** Contact: Microcomputer Managers Association International, Suite 359, 80 Boylston St., Boston, Mass. 02116.

September 12-13, San Jose, Calif. — **Microfocus Conference.** Contact: International Data Corp., 5 Speen St., Framingham, Mass. 01701.

September 12-13, Bethesda, Md. — **Planning and Implementing the Next Generation of Telecommunications Networks.** Also, September 26-27, Chicago. Contact: International Data Corp., Washington Division, Suite 240, 1500 Planning Research Drive, McLean, Va. 22102.

September 17-18, San Francisco — **Computers in Finance - Datamart.** Contact: Inter-Financial Association, 21 Tamal Vista Blvd., Corte Madera, Calif. 94925.

September 17-19, Dallas — **1985 Software/Expo.** Contact: Software/Expo, Suite 205, 2400 E. Devon Ave., Des Plaines, Ill. 60018.

September 18-20, Las Vegas, Nev. — **Apics Fall Seminar.** Contact: American Production and Inventory Control Society, Inc., 500 W. Annandale Road, Falls Church, Va. 22046-4274.

September 18-20, New York — **Unix Expo.** Contact: National Expositions Co., Inc., 14 W. 40th St., New York, N.Y. 10018.

September 18-20, New Brunswick/Somerset, N.J. — **Local-Area Networks.** Also, September 30-October 2, Boston. Contact: Data-Tech Institute, Lakeview Plaza, P.O. Box 2429, Clifton, N.J. 07015.

Computerworld Sales Offices

Donald E. Fagan, **Publisher/Vice-President.** Edward P. Marecki, **Vice President/Sales.** Kathy Doyle, **Manager/Marketing & Sales Operations,** Suzanne Weixel, **Special Publications Ad Coordinator.** COMPUTERWORLD, 375 Cochituate Road, Box 880, Framingham, Mass. 01701, Phone: (617) 879-0700, Telex: 95-1153.

BOSTON SALES OFFICE: Ronald Mastro, **Northern Regional Manager.** Jim McClure, Michael F. Kelleher, David Peterson, Bill Cadigan, **District Managers.** Sherri Driscoll, **Account Manager.** Alice Longley, **Sales Assistant.** COMPUTERWORLD, 375 Cochituate Road, Box 880, Framingham, Mass. 01701, Phone: (617) 879-0700, Telex: 95-1153.

NEW YORK SALES OFFICE: Michael J. Masters, **Eastern Regional Director.** Doug Cheney, **Senior District Manager.** Joan Daly, Fred LoSapio, **District Managers.** Gale M. Paterno, **Account Manager.** Mary Burke, **Sales Assistant.** COMPUTERWORLD, Paramus Plaza I, 140 Route 17 North, Paramus, N.J. 07652, Phone: (201) 967-1350.

CHICAGO SALES OFFICE: Russ Gerches, **Midwest Regional Manager.** Art Kossack, Kevin McPherson, **District Managers.** Jean F. Broderick, **Sales Assistant.** COMPUTERWORLD, 2600 South River Road, Suite 304, Des Plaines, Ill. 60018, Phone: (312) 827-4433.

LOS ANGELES SALES OFFICE: Bernie Hockswender, Robert Meth, **District Managers.** Beverly Raus, **Account Coordinator.** William J. Healey, **Western Regional Director.** COMPUTERWORLD, 18008 Skypark Circle, Suite 260, Irvine, Calif. 92714, Phone: (714) 261-1230.

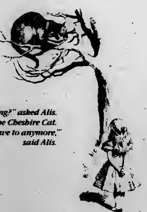
SAN FRANCISCO SALES OFFICE: William J. Healey, **Western Regional Director.** Barry G. Milione, **Senior District Manager.** Ernie Chamberlain, Mark V. Glasner, **District Managers.** Ruth Gordon, **Account Coordinator.** Nicole Boothman, **Recruitment Account Manager.** COMPUTERWORLD, 300 Broadway, Suite 20, San Francisco, Calif. 94133, Phone: (415) 421-7330.

ATLANTA SALES OFFICE: Jeffrey Melnick, **District Manager.** Michael J. Masters, **Eastern Regional Director.** COMPUTERWORLD, 1400 Lake Hearn Drive, Suite 330 Atlanta, GA 30319. Phone: (404) 394-0758.

DALLAS SALES OFFICE: William Mahoney, **District Manager.** William J. Healey, **Western Regional Director.** COMPUTERWORLD, 14651 Dallas Pky., Suite 304, Dallas, TX 75240, (214) 991-8366.

Advertisers' Index

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.



"What are you doing?" asked Alis.
"I'm waiting," replied the Cheshire Cat.
"Well, you won't have to anymore," said Alis.

If you've been waiting for the transportable office software system of the future, your wait is over.

Right now, more than a dozen major international computer manufacturers have decided to offer Unix*-based Alis,* a major advance in the world of office software.

To see what the excitement's about, come to Info '85, October 14–17, and see Alis running across the PC AT,* VAX,* and Sun Workstation.* The wonderland of office automation will never be the same.

See Alis. And smile.

Alis combines text, spreadsheet, graphics and database in single, always editable documents ☐ handles proportionally-spaced and multiple-size fonts WYSIWYG-style ☐ provides automatic formatting of reports, letters, memos, etc. ☐ sophisticated equation-solving spreadsheet ☐ drawing and business graphics ☐ personal and office databases ☐ integrated electronic mail and meeting scheduling ☐ multiple windows ☐ supports graphic workstations and terminals

*Alis and Applix are trademarks of Applix, Inc.
*IBM PC AT is a registered trademark of International Business Machines, Inc.
*VAX is a registered trademark of Digital Equipment Corporation, Inc.
*Sun Workstation is a registered trademark of Sun Microsystems, Inc.

Alis™

The office software system from APPLiX

Finally, some answers in Wonderland.

APPLiX, INC., 112 TURNPIKE ROAD, WESTBORO, MA 01581 (617) 870-0300